BULLETIN No. 45.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF CHEMISTRY.

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ANALYSES OF CEREALS

COLLECTED AT THE

WORLD'S COLUMBIAN EXPOSITION,

AND

COMPARISONS WITH OTHER DATA.

BY

HARVEY W. WILEY,
CHIEF OF THE DIVISION OF CHEMISTRY.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1895.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., April 17, 1895.

SIR: I submit for your inspection a compilation of analyses of typical cereals exhibited at the World's Columbian Exposition, and request that it be published as Bulletin 45 of the Division of Chemistry.

Respectfully,

H. W. WILEY,
Chemist.

HON. J. STERLING MORTON,
Secretary.

CONTENTS.

	Page.
Preparation of the samples	8
Determination of moisture	8
Determination of ash	8
Determination of ether extract	8
Alternate method for ether extract	8
Estimation of nitrogen	8
Reagents	8
Apparatus	9
Manipulation	10
Moist gluten	10
Dry gluten	10
Crude fiber	10
Notes on methods of analysis	11
Description and analyses of barley	13
Notes on analyses of barley	16
Buckwheat	19
Description and analyses of buckwheat	20
Notes on analyses of buckwheat	21
Maize (Indian corn)	22
Description and analyses of maize	23
Notes on analyses of maize	25
Oats	26
Description and analyses of oats	27
Notes on analyses of oats	30
Rice	31
Description and analyses of rice	32
Notes on analyses of rice	34
Rye	35
Description and analyses of rye	36
Notes on analyses of rye	38
Wheat	39
Description and analyses of wheat	40
Discussion of wheat analytical data	49
Characteristics of the wheat grain	51
Mean data calculated from the analyses of samples exhibited at the World's Columbian Exposition	53
Approximate typical composition of domestic samples taken from the data given in the preceding pages	53

TYPICAL CEREALS.

COMPOSITION OF CEREALS EXAMINED FOR THE JUDGES OF AWARDS AT THE WORLD'S COLUMBIAN EXPOSITION.

By direction of the Secretary of Agriculture, the Division of Chemistry placed at the disposal of the authorities of the World's Columbian Exposition the laboratory at Jackson Park, Chicago, for the purpose of assisting in the determination of the value of food products in competition for awards.

Early in July of 1893 the author was directed to take charge in person of this work, and to assist the judges in their labors in every possible way. For some reason the committee of jurors on cereal products did not get to their work as promptly as was expected. Instead of having the samples ready for analysis the latter part of July, it was not until September that the analytical work could be begun. The number of samples, therefore, which could be examined was very much less than had been expected. In addition to the regular force of the Division of Chemistry detailed for the work, the valuable assistance of one of the jurors, Mr. Frank T. Shutt, chemist of the experimental farms at Ottawa, Canada, was secured in the laboratory.

On account of the late date at which the analytical work was commenced, it was found impracticable to do the whole of it at the Chicago laboratory. An arrangement was therefore made with the jurors to use only certain data of the analyses in giving the awards. By this arrangement the analyses were to be finished in the laboratory at Washington. The data which were submitted to the jurors, and which were determined in the laboratory at Chicago, were the weight of 100 kernels, the percentage of moisture, the percentage of albuminoids, and the percentage of ash; while the data which were obtained at the Washington laboratory subsequently were the percentages of dry and wet gluten in the wheat and wheat flours and the percentages of ether extract and the fiber. The starches and other carbohydrates were calculated in the usual way by difference.

The methods of analysis pursued were, with one or two minor changes not affecting the results except in the way of securing more

rapid work, those adopted by the Association of Official Agricultural Chemists. Inasmuch as many who will receive this bulletin do not have access to these methods, they are given below:

PREPARATION OF THE SAMPLES.

Samples of cereals are ground in a small mill until they pass a sieve with a half-millimeter mesh.

DETERMINATION OF MOISTURE.

Two grams of the substance in a flat-bottomed aluminum dish are dried for five hours at the temperature of boiling water. Experience has shown that after this time no further loss of weight takes place.

DETERMINATION OF ASH.

Char from 2 to 3 grams of the substance and burn to whiteness at the lowest possible red heat. If a white ash can not be obtained in this manner, exhaust the charred mass with water; collect the insoluble residue on a filter, burn, add this ash to the residue from the evaporation of the above aqueous extract, and heat the whole to a low redness till the ash is white.

DETERMINATION OF ETHER EXTRACT.

Extract from 2 to 3 grams of the substance dried as for the determination of the moisture, with anhydrous and alcohol-free ether, for sixteen hours. Dry the extract, by exposure to the full heat of boiling water, to constant weight.

ALTERNATE METHOD FOR ETHER EXTRACT.

In determining hygroscopic water, as above, continue the drying until the loss of weight in thirty minutes is reduced to 1 milligram or less; extract the dried substance for sixteen hours as directed, dry again, and give loss of weight as ether extract.

Anhydrous ether.—To prepare the anhydrous alcohol-free ether required for estimation of fat, take any of the commercial brands of ether, wash with two or three successive portions of distilled water, add sticks of solid caustic soda or potash until most of the water has been abstracted from the ether. Carefully cleaned metallic sodium, cut into small pieces, is now added until there is no further evolution of hydrogen gas. The ether thus dehydrated must be kept over metallic sodium, and should be only lightly stoppered in order to allow any accumulating hydrogen gas to escape; and it may be drawn off with a pipette as required.

ESTIMATION OF NITROGEN.

REAGENTS.

(1) *Acid.*—(*a*) Standard hydrochloric acid, the absolute strength of which has been determined by precipitating with silver nitrate and weighing the silver chlorid, as follows:

To any convenient quantity of the acid to be standardized add a solution of silver nitrate in slight excess and then 2 c. c. of pure nitric acid of 1.2 sp. gr.; heat to the boiling point, and keep at this temperature for some minutes, but without violent ebullition, and with constant stirring, until the precipitate assumes the granular form. Allow to cool somewhat, and then pass the fluid through the asbestus. Wash the precipitate by decantation, with 200 c. c. of very hot water, to which have been added 8 c. c. nitric acid and 2 c. c. dilute solution of silver nitrate containing 1

gram of the salt in 100 c. c. of water. The washing by decantation is performed by adding the hot mixture in small quantities at a time, and beating up the precipitate well with a thin glass rod after each addition. The pump is kept in action all the time, but to keep out dust during the washing the cover is only removed from the crucible when the fluid is to be added.

Put the capsule and precipitate aside, return the washings once through the asbestos so as to obtain them quite clear, remove them from the filter and set aside to recover excess of silver. Rinse the receiver and complete the washing of the precipitate with about 200 c. c. of cold water. Half of this is used to wash by decantation, and the remainder to transfer the precipitate to the crucible with the aid of a trimmed feather. Finish washing in the crucible, the lumps of silver chlorid being broken down with the glass rod. Remove the second filtrate from the receiver and pass about 20 c. c. of 98 per cent alcohol through the precipitate. Dry at 140 to 150°. Exposure for half an hour is found more than sufficient, at this temperature, to dry the precipitate thoroughly.

Or (*b*) standard sulphuric acid the absolute strength of which has been determined by precipitation with barium chlorid and weighing the resulting barium sulphate.

For ordinary work half normal acid is recommended, i. e., acid containing 18.2285 grams of hydrochloric acid or 24.5185 grams sulphuric acid to the liter; for work in determining very small amounts of nitrogen, one-tenth normal acid is recommended. In titrating mineral acids against ammonia solutions, use cochineal as indicator.

(2) *Standard alkali*, the strength of which, relative to the acid, has been accurately determined. One-tenth normal ammonia solution, i. e., containing 1.7051 grams of ammonia to the liter, is recommended for accurate work.

(3) *Sulphuric acid*, specific gravity 1.84, free from nitrates and also from ammonium sulphate, which is sometimes added in the process of manufacture to destroy oxids of nitrogen.

(4) *Metallic mercury* or mercuric oxid, prepared in the wet way. That prepared from mercuric nitrate can not be safely used.

(5) *Potassium permanganate* finely pulverized.

(6) *Granulated zinc*, pumice stone, or 0.5 gram of zinc dust is to be added to the contents of the flasks in distillation, when found necessary, in order to prevent bumping.

(7) *Potassium sulphid.*—A solution of 40 grams of commercial potassium sulphid in 1 liter of water.

(8) *Soda.*—A saturated solution of sodium hydrate free from nitrates.

(9) *Indicator.*—Solution of cochineal prepared as follows: Tincture of cochineal is prepared by digesting and frequently agitating 3 grams of pulverized cochineal in a mixture of 50 c. c. of strong alcohol with 200 c. c. of distilled water, at ordinary temperatures, for a day or two. The solution is decanted or filtered through Swedish paper.

APPARATUS.

(1) *Kjeldahl digestion flasks* of hard, moderately thick, well-annealed glass. These flasks are about 22 cm. long, with a round, pear-shaped bottom, having a maximum diameter of 6 cm., and tapering out gradually in a long neck, which is 2 cm. in diameter at the narrowest part, and flared a little at the edge. The total capacity is 225 to 250 c. c.

(2) *Distillation flasks* of ordinary shape, of 550 c. c. capacity, or preferably flasks of the same capacity of well-annealed glass and of pear-shaped bottom, for both digestion and distillation, fitted with a rubber stopper and a bulb tube above to prevent the possibility of sodium hydrate being carried over mechanically during distillation. The bulbs are about 3 cm. in diameter, the tubes being of the same diameter as the condenser and cut off obliquely at the lower end. The bulb tube is adjusted to the condenser by a rubber connection.

MANIPULATION.

(1) *The digestion.*—From 0.7 to 3.5 grams of the substance to be analyzed, according to its proportion of nitrogen, are brought into a digestion flask with approximately 0.7 gram of mercuric oxid or its equivalent in metallic mercury and 20 c. c. of sulphuric acid. The flask is placed in an inclined position, and heated below the boiling point of the acid for from five to fifteen minutes or until frothing has ceased. If the mixture froth badly, a small piece of paraffin may be added to prevent it. The heat is then raised until the acid boils briskly. No further attention is required till the contents of the flask have become a clear liquid, which is colorless, or at least has only a very pale straw color. The flask is then removed from the frame, held upright, and, while still hot, potassium permanganate is dropped in carefully and in small quantities at a time till, after shaking, the liquid remains of a green or purple color.

(2) *The distillation.*—After cooling, the contents of the flask are transferred to the distilling flask with about 200 c. c. of water, with a few pieces of granulated zinc, pumice stone, or 0.5 gram of zinc dust when found necessary to keep the contents of the flask from bumping, and 25 c. c. of potassium-sulphid solution are added, shaking the flask to mix its contents. Next add 50 c. c. of the soda solution, or sufficient to make the reaction strongly alkaline, pouring it down the side of the flask so that it does not mix at once with acid solution. Connect the flask with the condenser, mix the contents by shaking, and distil until all ammonia has passed over into the standard acid. The first 150 c. c. of the distillate will generally contain all the ammonia. This operation usually requires from forty minutes to one hour and a half. The distillate is then titrated with standard alkali.

The use of mercuric oxid in this operation greatly shortens the time necessary for digestion, which is rarely over an hour and a half in case of substances most difficult to oxidize, and is more commonly less than an hour. In most cases the use of potassium permanganate is quite unnecessary, but it is believed that in exceptional cases it is required for complete oxidation, and in view of the uncertainty it is always used. The potassium sulphid removes all the mercury from the solution, and so prevents the formation of mercur-ammonium compounds which are not completely decomposed by soda solution. The addition of zinc gives rise to an evolution of hydrogen and prevents violent bumping. Previous to use the reagents should be tested by a blank experiment with sugar, which will partially reduce any nitrates that are present, which might otherwise escape notice.

MOIST GLUTEN.

Place 10 grams of the sample in a porcelain dish and moisten with from 6 to 7 c. c. of cold water, knead, and allow to stand for an hour. Work into a ball, being careful that none of the material adheres to the dish. Holding the mass in the hand knead it in a slow stream of cold water until the starch and all soluble matter are washed out. Place the ball of gluten thus formed in cold water and allow to stand for one hour; remove from the water, press as dry as possible between the hands, roll into a ball, and weigh in a flat-bottomed dish.

DRY GLUTEN.

After weighing place the ball of moist gluten in the drying oven at a temperature of boiling water for twenty-one hours; cool and weigh.

CRUDE FIBER.

The residue from the ether extract may be used for this determination. To this residue in a half liter flask or beaker add 200 c. c. of boiling 1.25 per cent sulphuric acid. Continue the boiling for thirty minutes,

filter, wash thoroughly with boiling water till the washings are no longer acid; remove the substance from the filter into the same beaker with 200 c. c. of hot 1.25 per cent solution of sodium hydrate, free of sodium carbonate; boil for thirty minutes, filter through a gooch and wash with boiling water till the washings are neutral; dry to constant weight and incinerate after weighing. The loss in weight by incineration will give the quantity of crude or indigestible fiber. The most convenient filtering material for the first filtration is fine linen, although any other method which secures a clear filtrate and rapid work may be used. The strength of the solutions of acid and alkali should be accurately determined by titration.

NOTES ON METHODS OF ANALYSIS.

The total albuminoids are obtained by multiplying the percentage of nitrogen found by 6.25. The starch and soluble carbohydrates, including all bodies soluble in the reagents employed, are obtained by difference—that is, the sum of the moisture, ash, ether extract, albuminoids, and crude fiber subtracted from 100. The percentage of starch in this material varies largely with different cereals and even with different samples of the same cereal, but inasmuch as all these carbohydrate bodies are supposed to have almost the same food value no attempt has been made to separate them.

In regard to the slight variations from standard methods which are mentioned above, the only one of importance is that referring to the determination of fiber. It is found in our experience here that heating in beakers covered with watch glasses is quite as efficient as the method prescribed by the association, and where so many samples are to be examined the greater speed which is secured by doing away with the process of directing a current of air on the foaming mass while boiling is a matter of considerable importance.

Another variation from the official method was in the determination of moisture. At Chicago no facilities were afforded for the determination of moisture in a current of hydrogen. Experience has shown that there is practically no difference in the analytical data secured on samples dried in the open air, in a partial vacuum and in a current of hydrogen, and for this reason the drying in the air, which is so much more easily accomplished, has been followed.

The methods used for moist and dry gluten have not been adopted by the Association of Official Agricultural Chemists. They are the processes which are used in this laboratory and which have given us satisfactory results. The determination of moist and dry gluten can not in any sense be regarded as an exact analytical process. For millers' purposes, however, the numbers have considerable value, showing the comparative percentage of glutinous matter in the different samples. For obvious reasons the determination of dry and moist gluten was confined to samples of wheat and wheaten flour.

The data which were used by the judges in determining the value of a given sample were the percentage of moisture, the percentage of ash, and the percentage of albuminoids. Inasmuch as it was not possible to determine the ether extract and indigestible fiber in the time at our disposal the average content of these constituents in the several cereals under examination was assumed to be that found in previous work of the division, and these average data were also considered in the determination of awards. For food values for comparative purposes, it was assumed that the albuminoids and fats were two and one-half times as valuable as the carbohydrates and the total comparative value of each sample for food purposes was determined by multiplying the percentage of carbohydrates by one and the percentages of albuminoids and fats each by 2.5 and taking the sum of their products. It was considered that these were sufficient data for the purposes of the jury of awards.

In the following tables will be found the analytical data obtained. The albuminoids were determined by Messrs. T. C. Trescot and F. T. Shutt. The moisture and ash were determined by other assistants in Chicago. The ether extract was determined by Mr. J. S. Carman, the insoluble fiber by Messrs. Krug and Trescot, and the moist and dry glutens by Mr. T. C. Trescot.

For convenience of reference the means of the analytical data obtained are compared with those secured in the previous work of this Division and which were published in Bulletins Nos. 1, 4, and 9. These bulletins are now out of print and this tabulation of the mean data will be of especial use to workers who are unable to consult the original data.

Comparisons are also made with the mean data of cereal analyses contained in the Bulletin No. 11 of the Office of Experiment Stations compiled by Jenkins and Winton. To complete as far as possible a tabular view of our present knowledge of the composition of cereals the mean data given by König and Dietrich in their compilation of the analyses of foods have been used.

In the data from König and Dietrich given in the tables of means, the percentages of moisture in each case are as found by weighing. For purposes of comparison, however, the other data are calculated to the water content of the general mean given in the first number of the series.

Description and analyses of barley.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		CALIFORNIA.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
12181	47	Nublas Coebner, Los Angeles	Commercial barley	55	49	4.079	10.35	8.58	2.22	5.15	2.47	71.23
		ILLINOIS.										
17796	2	Robert Shedden, Pingree Grove	Golden melon	48	57	4.628	11.77	9.89	2.03	3.87	2.49	69.95
17797	3	do	Beardless white	43	54	5.157	11.31	8.67	2.32	4.07	2.34	71.49
17798	4	do	Prolific barley	52	50	4.899	11.72	8.32	2.07	4.22	2.20	71.47
		Means				4.895	11.60	8.96	2.14	4.05	2.34	70.97
		INDIANA.										
8629	42	Willard Smith, Bellemore	Spring barley	42	56	3.403	11.47	10.33	2.05	5.62	2.52	68.01
		KANSAS.										
112	1	S. H. Williams, Abilene	White barley	42		3.190	11.57	11.73	1.93	5.07	2.95	66.75
		MICHIGAN.										
20463	59	E. A. Parks, Waterloo	Purple barley		58.50	4.873	9.35	13.83	2.19	1.85	2.44	70.34
		MINNESOTA.										
2481	13	H. Winslow, Beltramie	White barley			4.445	9.24	12.78	2.42	4.55	2.64	68.37
		NEW YORK.										
4176	33	A. T. Leach, Lyons	Barley, two-rowed	55	54	3.987	11.57	9.98	2.09	3.75	2.43	71.18
4182	34	Anna G. Timmerman, Medina	do	52	51.50	3.852	11.92	11.20	2.18	4.25	2.42	68.03
4183	35	A. A. Donolds, Medina	do	47	51.25	3.972	12.96	10.68	1.89	3.85	2.45	68.17
4192	36	S. D. Howell, Mellville	do	50	52	4.760	10.78	11.20	2.17	3.67	2.46	69.72
4193	37	Fred. Murdock, Medina	do	53	51.50	4.030	12.68	11.20	2.11	4	2.28	67.73
4206	38	A. D. Grimmell, East Shelby	do	55	54.75	4.009	11.66	11.20	2.12	4.50	2.42	68.10
4207	39	N. G. Coon, Medina	do	55	52.25	3.860	11.14	11.20	2.11	3.70	2.75	69.10
4209	40	J. Burch, Medina	do	50	50.75	4.064	11.11	11.20	2.05	4	2.89	68.75
4210	41	John Sherwood, Medina	do	48	52.25	4.182	11.07	10.33	2.12	4.10	2.57	69.81
		Means				4.079	11.65	10.91	2.09	3.98	2.52	68.84

Description and analyses of barley—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		OHIO.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
11125	44	Whipps Bros., Marion	Barley, two-rowed	42	51	3.245	11.12	12.08	2.08	4.40	1.71	68.61
11126	45	do	Barley, four-rowed	Good.		3.316	11	10.33	2.09	5	2.59	68.99
		Means				3.280	11.06	11.20	2.09	4.70	2.15	68.80
		PENNSYLVANIA.										
2892	14	Samuel Wilson, Mechanicsville	California Prolific	42	48	3.897	8.92	12.95	2.41	4.47	2.83	68.42
		UTAH.										
16185	53	Utah Agricultural College, Logan	Lump Blue barley			4.315	9.98	10.50	1.89	4.57	2.42	70.64
16186	54	do	Black barley		66	4.050	10.24	11.90	2.01	1.57	2.26	72.02
16190	55	do	New Zealand barley			3.276	10.03	10.85	2.22	3.50	2.80	70.60
16192	56	do	Standard barley		54	4.765	9.75	8.93	2.15	4	1.70	73.47
16193	57	do	Solzers's California Prolific			4.357	8.95	10.68	2.35	3.50	2.59	71.93
16194	58	do	Common barley			4.810	9.66	9.63	2.14	4	1.65	72.92
		Means				4.262	9.77	10.42	2.11	3.52	2.24	71.93
		WASHINGTON.										
12772	46	State of Washington, Olympia	White brewing barley	50	49.50	4.250	10.60	9.63	2.05	4.40	2.50	70.82
13900	48	W. O. Bush, Olympia	Northumberland	43	53	4.218	10.91	9.63	2.09	4.72	2.58	70.07
13901	49	do	Provosteer barley	48	53	5.078	10.60	8.93	2.19	4	2.54	71.74
13903	50	do	Highland Chief			5.249	10.32	9.63	2.16	4	2.24	71.65
		Means				4.699	10.61	9.46	2.14	4.28	2.47	71.07
		WISCONSIN.										
15553	29	Adam Graver, Waukesha	Barley	40	52	3.240	11.72	10.85	2.27	5.17	2.75	67.24
		WYOMING.										
14118	51	A. A. Lambrigger, Big Horn	New black or purple	54	50	4.090	10.32	12.08	2.23	2	2.24	71.13
		Total means, United States				4.192	10.80	10.69	2.13	4.05	2.44	69.89

		ARGENTINE REPUBLIC.										
23172	24	Benj. Brunt, Chubat	Barley	62.5	58	4.354	12.07	8.58	2.21	4.10	2.91	70.13
23454	25	P. and A. Lanusse, Buenos Ayres	do	62.5	55	4.016	13.25	11.90	1.05	3.77	2.61	67.42
		Means				4.185	12.66	10.24	1.63	3.94	2.76	68.78
		CANADA.										
7897	15	Ontario Agricultural College, Guelph, Ontario.	Empress, two-rowed			4.300	9.15	11.03	2.17	4.07	2.55	71.03
7901	16	do	Improved Cayenne, two-rowed			3.856	11.52	10.59	2.24	5	2.66	67.99
7902	17	do	Order Breaker, six-rowed			3.882	10.75	9.89	2.25	4.35	2.68	70.08
7905	18	do	Imperial, two-rowed			5.368	10.68	10.68	2.22	4.35	2.56	69.51
18416	5	Richard P. Wilson, Trafalgar, Ontario	Duckbill, two-rowed			5.718	11.48	10.24	2.36	3.77	2.43	69.72
18420	6	do	Barley, two-rowed			5.507	12.65	10.24	2.38	3.82	2.36	68.55
18421	7	do	do	46		5.897	12.10	10.68	2.32	4.05	2.39	68.46
18422	8	do	Barley, six-rowed			4.809	12.10	10.85	2.11	4.60	1.88	68.46
18423	9	George Baker, Woodhouse	do			4.265	11.89	11.20	2.14	4.37	2.44	67.96
18424	10	Gaylord Greenman, Charlotteville	Barley, two-rowed			5.038	11.38	11.03	2.19	3.90	2.13	69.37
18428	11	Thomas Puzey, Woodhouse	do			5.597	11.41	11.20	2.06	3.60	2.32	69.41
18432	12	Ralph Brewels, White Church, Ontario	Duckbill, two-rowed	54		5.598	10.99	10.85	2.29	3.87	2.55	69.45
18478	19	Andrew Clifford, St. Josephs Island	Kendall Chevalier			5.768	12.74	10.68	2.05	4.07	2.43	68.03
18479	20	do	Barley			5.520	12.38	9.28	2.28	4.50	2.25	69.31
18484	21	Major Thos. Walker, Ancaster, Ontario	Barley, two-rowed			5.820	12.07	10.68	2.44	3.87	2.31	68.63
18488	22	Wm. Tuck, Nelson, Ontario	do	50	52	5.820	12.87	11.03	2.29	3.75	2.42	67.64
27756	26	Wm. Tuck, Watertown, Ontario	do	50	52	5.783	13.61	10.50	.56	4.05	2.43	68.80
27757	23	Richard P. Wilson, Trafalgar, Ontario	do	46		5.797	13.55	10.50	1.24	4	2.36	68.35
27758	28	Ralph Brewels, White Church, Ontario	do	54	(*a*)	5.547	12.47	11.03	2.38	4.12	2.58	67.42
27760	27	T. Pyke, Markham, Ontario	do	40	(*b*)	5.351	13.40	9.28	1.26	3.95	2.32	69.79
		Means				5.262	11.96	10.57	2.06	4.10	2.41	68.90
		SPAIN.										
30498	30	Giraldo Cerespo (Ensebia), Medina del Campo.	Barley			5.731	11.67	9.45	1.75	4.50	2.40	70.23
		Total means, foreign barleys				5.007	12.01	10.49	2.01	4.11	2.43	68.97
		Total means, all barleys				4.533	11.31	10.61	2.09	4.07	2.44	69.47

a Over standard.

b Heavy weight.

The total number of samples examined, grown in the United States, was 32. The mean composition of all the samples was as follows:

The weight of 100 kernels, 4.192 grams; moisture, 10.80 per cent; albuminoids, 10.69; fat or ether extract, 2.13 per cent; indigestible or crude fiber, 4.05 per cent; ash, 2.44 per cent; starch, sugar, and other digestible carbohydrates, by difference, 69.89 per cent.

A tabular comparison of these averages with those obtained in previous examinations by the Department (Bulletin No. 9, Div. of Chemistry) and compiled by Jenkins and Winton (Exp. Sta. Bull. No. 11), will be of interest.

	World's Columbian Exposition samples (32).	Samples previously analyzed in Division of Chemistry (60).	Samples collated by Jenkins and Winton (10).
Weight of 100 kernels.....grams..	4.192	3.482	
Moisture.....per cent..	10.80	6.53	10.90
Albuminoids.....do....	10.69	11.33	12.40
Ether extract.....do....	2.13	2.68	1.80
Indigestible fiber.....do....	4.05	3.80	2.70
Ash.....do....	2.44	2.89	2.40
Carbohydrates, by difference.....do....	69.89	72.77	69.80
Total.....do....	100	100	100

The greatest point of difference between these analyses and those made in former years is found in the percentage of moisture. It is difficult now to reconcile the discrepancy, but it appears that the difference makes a marked contrast, as would naturally be expected, in the other data, raising as a rule all of the other constituents in proportion as the water diminishes. The difference in the weight of the kernels is also marked, and this is due to the fact that naturally the finest and plumpest kernels would be sent to the Exposition. This and the diminished amount of water in the former samples examined are sufficient to account for the larger average weight of 100 kernels as exhibited at the Columbian Exposition.

In a barley the two most important characteristics for brewing purposes, aside from the diastatic action of malt, are the percentages of carbohydrates, principally starch, and of the albuminoids. In the three classes of barleys examined, as indicated in the above table, the carbohydrates reduced to water-free basis are 78.26 per cent, 77.85 per cent, and 78.34 per cent, respectively; and the albuminoids 11.97 per cent, 12.12 per cent, and 13.92 per cent, respectively. It is seen, therefore, that there is not a very great difference in the averages of the three different classes when reduced to a water-free basis, save in the higher percentage of albuminoids in class three.

The weight per bushel and the yield per acre in all cases were given by the exhibitors, and the evidence substantiating the statements made was not communicated to this division by the judges of awards. In respect of extremes of variation, the following data will be of interest:

In the United States the largest grains of barley were grown in Washington and the smallest in Kansas. In moisture the largest percentage was found in a New York sample, viz, 12.96, and the smallest in a sample from Pennsylvania, viz, 8.92. In Canada the maximum and minimum percentages found were 13.61 and 9.15, respectively. Among foreign exhibits the highest percentage of moisture, viz, 13.25, was found in a sample from the Argentine Republic, and the lowest, viz, 11.67, in a sample from Spain. The comparisons of the other constituents of the barley in regard to maxima and minima and means can be seen with sufficient detail in the following table:

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
Domestic:	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Maxima	*a* 5.249	*b* 12.96	*c* 13.83	*d* 2.42	*c* 5.62	*f* 2.95	*g* 73.47
Minima	*f* 3.190	*h* 8.92	*i* 8.32	*b* 1.89	*g* 1.57	*g* 1.65	*f* 66.75
Means	4.192	10.80	10.69	2.13	4.05	2.44	69.89
Canada:							
Maxima	5.897	13.61	11.20	2.44	5	2.68	71.03
Minima	3.856	9.15	9.28	.56	3.60	1.88	67.42
Means	5.262	11.96	10.57	2.06	4.10	2.41	68.90
Foreign:							
Maxima	*j* 5.731	*k* 13.25	*k* 11.90	*k* 2.21	*j* 4.50	*k* 2.91	*j* 70.23
Minima	*k* 4.016	*j* 11.67	*k* 8.58	*k* 1.05	*k* 3.77	*j* 2.40	*k* 67.42
Means	5.007	12.01	10.49	2.01	4.11	2.43	68.97

a Washington. *b* New York. *c* Michigan. *d* Minnesota. *e* Indiana. *f* Kansas. *g* Utah. *h* Pennsylvania. *i* Illinois. *j* Spain. *k* Argentine Republic.

For a more detailed description of the composition of barley the results of some former work in the Division of Chemistry may be cited (Bulletin No. 9, p. 77):

Number of analyses		14
Water	per cent	6.47
Ash	do	2.87
Oil	do	2.67
Sugar	do	7.02
Dextrin and soluble starch	do	3.55
Starch	do	62.09
Albuminoids soluble in 80 per cent alcohol	do	3.66
Albuminoids insoluble in 80 per cent alcohol	do	7.86
Indigestible fiber	do	3.81

The following means are given by König-Dietrich for barleys from different countries:

	Number of analyses.	Water.	Albuminoids.	Oil.	Carbohydrates.	Indigestible fiber.	Ash.
		Per cent.	*Per cent.*	*Per ct.*	*Per cent.*	*Per ct.*	*Pr ct.*
Miscellaneous	263	14.05	9.71	1.89	65.75	5.76	2.84
Middle and north Germany	120	*14.92	9.88	1.80	66.75	4.77	2.75
Southern and western Germany	185	15.84	9.62	2.30	64.84	6.70	2.49
Austria	105	14.38	9.02	1.87	67.13	5.53	2.40
Hungary	45	14.70	9.39	2.48	67.77	3.95	2.36
North Russia	9	13.83	10.40				2.24
South Russia	12	13.81	12.71				2.36
England and Scotland	51	16.01	9.80	2.17	64.45	6.84	2.69
France	62	14.97	9.08	1.64	65.43	7.31	2.49
Sweden and Norway	23	14.71	9.35				2.20
Denmark	3	15.66	8.98				2.36
Turkey	25	12.40	8.78	1.82	71.19	2.16	2
Africa	15	12.76	8.98	1.74	71.12	1.96	2.15
North America	101	7.01	10.48	2.42	66.94	3.47	2.64
Hulled barleys grown in United States (Bull. 9, p. 75)	15	6.26	11.77	2.66	75.53	1.60	2.18

*In this and the following numbers the mean percentages of water found are given, but the other data are calculated to the basis of the percentage of water in the first instance, viz, 14.05.

A typical unhulled American barley should have approximately the following composition:

	Per cent.
Moisture	10.85
Albuminoids	11.00
Oil	2.25
Indigestible fiber	3.85
Ash	2.50
Digestible carbohydrates	69.45

In a general comparison of the samples exhibited at the World's Columbian Exposition it is seen that the average data obtained represent very nearly the mean composition of barleys the world over. They show decidedly more moisture than those formerly examined by the Division of Chemistry, but less than the majority of foreign barleys as quoted by König. Representing as they do the presumably typical barleys and the best of their classes their composition, as revealed by the analyses given, may be taken as a standard of comparison for barleys in general.

No attempt was made in the analyses to determine the comparative value of the samples for brewing purposes, and this can not be well determined by chemical analysis alone. Some authorities object to barleys rich in albuminoids for brewing purposes, but, inasmuch as the nutritive value of a beer depends largely upon its percentage of albuminoid matter, it is not readily seen how the objection can hold from a dietetic point of view. On the other hand, beers which have a high content of proteid matter are more difficult to preserve in a bright, sparkling condition than those whose nitrogenous content is low. The choice therefore of a barley for brewing purposes must depend largely on the judgment of the brewer as to the purposes for which the beer is to be used. There is no reason to suppose that the barleys grown in

the United States would prove inferior to those of other countries, provided the varieties best suited to beer manufacture were cultivated and properly developed. Climatic and soil conditions, as well as methods of fertilization, would undoubtedly have a tendency to vary the composition of the crop, but by judicious choice among the barleys rich or poor in albuminoids or other constituents the scientific brewer can undoubtedly secure a mixture which will satisfactorily meet the demands of his customers.

BUCKWHEAT.

But few samples of this cereal were offered for analysis, and these were wholly of American origin. The whole number embraced 7 samples from the United States and 3 samples from Canada. The composition of the samples and the mean composition of all are shown in the table on the following page.

Description and analyses of buckwheat.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		INDIANA.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
8635	6	Chas. Dibler, Patriot	Japanese buckwheat			3.383	11.90	11.38	2.20	9.70	1.99	62.83
8636	7	Ed. Shoemaker, Columbia City	Silver hulled buckwheat			3.380	11.80	11.55	2.33	11.15	1.91	61.26
8637	8	Frank Woods, Princeton	Japanese buckwheat			3.312	12.29	11.90	1.92	11.02	1.86	61.01
8638	9	Henry Thomas, La Fontaine	do			3.303	11.80	10.50	2.43	12.45	1.63	61.12
		Means				3.345	11.95	11.33	2.22	11.08	1.85	61.56
		MICHIGAN.										
20372	5	J. Elder, Pearson	Silver hulled buckwheat			2.350	11.75	11.55	2.08	9.57	1.90	63.15
		MINNESOTA.										
2362	1	Cosgrove Live Stock Company, Le Sueur	Japanese buckwheat	50	56	3.100	13.	9.19	1.74	10.19	1.74	64.14
2484	2	James Walsh, Little Falls	do	40	56	3.008	12.52	9.19	2.06	11.17	2.23	62.83
		Means				3.054	12.76	9.19	1.90	10.68	1.99	63.49
		Total means, United States				3.119	12.15	10.75	2.11	10.75	1.89	62.33
		CANADA.										
18618	3	George N. Harris, Beverly, Ontario	Buckwheat	35		2.203	12.82	10.94	2.62	9.09	1.57	62.96
18622	4	W. H. R. Talbot, London	do			3.400	13.14	11.03	1.31	10.77	1.69	62.06
27696	10	do	Japanese buckwheat	27		3.250	12.12	11.38	1.87	10.62	1.94	62.07
		Means				2.951	12.69	11.12	1.93	10.16	1.73	62.36
		Total means, all buckwheats				3.069	12.31	10.86	2.06	10.57	1.85	62.34

The samples containing the largest and smallest grains were both from Canada, 100 kernels weighing 3.400 and 2.203 grams, respectively. In regard to size the samples from Indiana were the most uniform, each of the individual samples being very near the mean in weight. The percentage of moisture is remarkably uniform in all the samples, the maximum being 13.14 per cent in a Canada sample and the minimum 11.75 per cent in a sample from Michigan. In respect of albuminoids the highest percentage, 11.90, was found in an Indiana, and the lowest, 9.19, in a Minnesota sample. In oil content the highest was a Canada sample with 2.62 per cent, and the lowest, also from Canada, with 1.31 per cent. The extremes in regard to the other constituents will be found by inspecting the table given below. In regard to the indigestible fiber, it should not be forgotten that the hull of the kernel was ground with the flour, and this fact explains why the indigestible fiber of the buckwheat flour is so much higher than that of ordinary cereals.

In the table which follows are found the maxima, minima, and means for domestic samples and those from Canada from the World's Fair exhibits compared with the mean data as given in Jenkins and Winton's compilation of American feeding stuffs and in König and Dietrich's tables of the constitution of foods:

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
Domestic:	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Maxima	*a* 3.383	*b* 13.00	*a* 11.90	*a* 2.43	*a* 12.45	*b* 2.23	*b* 64.14
Minima	*c* 2.350	*c* 11.75	*b* 9.19	*b* 1.74	*c* 9.57	*a* 1.63	*a* 61.01
Means	3.119	12.15	10.75	2.11	10.75	1.89	62.33
Canada:							
Maxima	3.400	13.14	11.38	2.62	10.77	1.94	62.96
Minima	2.203	12.12	10.94	1.31	9.09	1.57	62.06
Means	2.951	12.69	11.12	1.93	10.16	1.73	62.36
Jenkins and Winton (10 analyses):							
Means		12.60	10	2.20	8.70	2	64.50
König:							
Means of 14 analyses		14.12	11.32	2.61	14.32	2.77	54.86
Columbian Exposition samples:							
Means of 10 analyses	3.069	12.31	10.86	2.06	10.57	1.85	62.34

a Indiana. *b* Minnesota. *c* Michigan.

Comparing the analyses made with those given by König and Dietrich we find again that in the foreign samples the percentage of water is very much higher than in those of domestic origin. The indigestible fiber is also markedly higher and, as a consequence of the high percentages of moisture and indigestible fiber, the digestible carbohydrates are remarkably low. Buckwheat is a cereal which has received little attention from analysts, and the data at hand for comparison are therefore limited.

A typical American buckwheat should have approximately the following composition: Weight of a hundred kernels, 3 grams; moisture, 12

per cent; albuminoids, 10.75 per cent; oil, 2 per cent; indigestible fiber, 10.75 per cent; ash, 1.75 per cent; digestible carbohydrates, 62.75 per cent.

MAIZE (INDIAN CORN).

For some reason the number of samples of maize offered for analysis by the judges of awards was very small, and the great maize-producing States of Illinois, Iowa, and Missouri, as well as many others, are not represented at all in the samples analyzed. The few samples which were received, however, were of very fine quality and may be taken as fairly representative of the best maize products of the localities represented. The former work of the Department in the analysis of samples of maize is very comprehensive. The bulletins in which the results of these analyses were printed—viz, Nos. 1, 4, and 9—have had a wide circulation, and have been taken as containing the data necessary to form an estimate of the character of the maize products of this country. The deficiency, therefore, in the samples offered for analysis at the World's Columbian Exposition can be supplied by referring to the analyses made at a former period. This deficiency is not due to any lack of samples which were on exhibition, but simply to the failure of the judges to deliver the samples for examination. By reason of the fact that it was impossible to make an analysis of all the samples examined by the judges, it was deemed best by them to select only those which were peculiarly typical. While this was practiced with other cereals with reasonable success, for some reason they failed to apply this rule in the case of the samples of maize, and therefore the largest maize-producing regions of the United States are unrepresented. The detailed analyses of the samples delivered to the chemical laboratory follow.

Description and analyses of maize.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		NEW HAMPSHIRE.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
335	1	Warren Brown, Hampton Falls	Angel of Midnight	75	60	40.040	12.27	11.12	3.88	1.00	1.51	70.22
		INDIANA.										
444	2	James Riley, Thorntown	Riley's Favorite	60	59	33.045	12.32	8.84	3.80	1.62	1.32	72.10
446	10	do	Ivory Dent white corn	90	61	44.584	10.35	9.98	4.28	1.75	1.34	72.30
8599	23	J. A. Evert, Indianapolis	Capitol corn	70	57	37.855	10.08	8.58	2.94	1.92	1.41	75.07
8621	11	Indiana Experiment Station, La Fayette	Big Buckeye	62.36		36.250	9.80	9.80	3.99	2	1.31	73.10
8622	12	do	Mastodon Hunt	67		38.648	10.15	9.45	4.32	1.67	1.55	72.86
8623	13	do	Piaso Queen	74.49		42.192	10.60	9.80	4.21	2	1.32	72.07
8625	14	do	Learning corn	61.70		33.170	9.58	10.33	4.32	2	1.31	72.46
		Means				37.963	10.41	9.54	3.98	1.85	1.36	72.85
		KENTUCKY.										
1263	3	W. F. Knight, Nicholasville	White Dent			46.360	12.19	9.69	4.01	1.82	1.19	71.10
1266	4	M. V. Dulin, Crofton	Extra Sweet Bread	60		35.789	11.45	11.55	5.06	1.75	1.22	68.97
1275	5	Wm. F. Sneizer, Bellardsville	Yellow corn	50		48.312	11.41	9.80	4.11	2	1.32	71.36
		Means				42.820	11.68	10.35	4.39	1.86	1.24	70.45
		WISCONSIN.										
a15780	7	Nashold Bros., Rio	Red Popcorn	80	63	10.608	9.83	10.33	4.59	1.97	1.53	71.75
15808	8	S. D. Owen, Danford	Yellow Flint corn	b100	55	37.220	10.50	10.33	4.63	1.50	1.48	71.56
15814	9	H. Pansie, Princeton	King Chief Red Winter	b100	57.50	38.803	10.17	9.28	4.74	1.57	1.32	72.96
15882	22	Geo. S. Robertson, Weyannega	White Flint			37.753	11.12	9.37	4.39	1.50	1.45	72.27
15967	17	John Speiker, Burlington	Smut-nosed Flint	b100	61	43.106	11.11	10.50	4.26	1.60	1.34	71.19
15972	16	Andrew Stebbins, Melroso	Yellow Dent	b150	56.50	34.981	11.74	10.85	3.93	1.75	1.38	70.35
16064	18	W. H. Welcome, Hancock	Squaw Dent	b75	58.25	39.540	11.05	8.75	4.03	1.57	1.34	73.26
		Means				37.734	10.94	9.85	4.33	1.58	1.38	71.93
		Total means, United States				38.979	10.93	9.88	4.17	1.71	1.36	71.95

a This sample excluded from the averages.

b Ears.

Description and analyses of maize—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		ARGENTINE REPUBLIC.										
				Bushels.	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
23120	21	I. Bataglia, Buenos Ayres	Corn	83	57	25.250	11.36	11.55	4.78	1.92	1.61	68.78
23126	20	Exequil Belando, Buenos Ayres	do	88	61	24.046	12.45	11.55	4.38	1.80	1.80	68.02
		Means				24.648	11.91	11.55	4.58	1.86	1.71	68.40
		BULGARIA.										
30569	19	Penkoe M. Vassiltchen, Denagominoos	Corn	40	56.61	18.428	12.60	9.98	4.02	2.20	1.26	69.94
		NEW SOUTH WALES.										
5600	6	New South Wales commissioners, Sydney	Trophy maize	(*a*)	(*a*)	46.487	10.43	9.80	4.85	1.57	1.50	71.85
		Total means, foreign corn				28.553	11.71	10.72	4.51	1.87	1.54	69.65
		Total means, all corn				36.993	11.08	10.04	4.23	1.74	1.39	71.51

a No reliable data.

In regard to the more important constituents, the chief variations noted in the domestic products are as follows: In regard to moisture, both the largest and smallest content were found in samples from Indiana. In regard to the size and weight of the kernels, the finest sample was from Kentucky, in which each grain weighed nearly half a gram. The smallest reported was a Wisconsin sample, but this being one of pop corn could not be compared with the others. The next smallest sample was from Indiana, 100 kernels weighing only 33.045 grams.

In albuminoids Kentucky furnished the sample having the largest quantity and Indiana the smallest. A sample from Kentucky contained the highest percentage of oil and one from Indiana the lowest. The extreme variations in other constituents can be seen from the table below.

Of the foreign exhibits, the sample containing the heaviest and largest kernels was from New South Wales, and the one containing the smallest and lightest from Bulgaria. In moisture the Bulgarian sample occupied first position and one from New South Wales the last. A sample from the Argentine Republic contained the largest percentage of albuminoids and one from New South Wales the smallest. A sample from New South Wales had the highest and one from Bulgaria the lowest content of oil. Following is the table of comparisons of maxima, minima, and means of the samples analyzed from the Columbian Exhibition.

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
Domestic corn:	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Maxima	*a* 48.312	*b* 12.32	*a* 11.55	*a* 5.06	*b* 2	*b* 1.55	*b* 75.07
Minima	*c* 10.608	*b* 9.58	*b* 8.58	*b* 2.94	*d* 1	*a* 1.19	*a* 68.97
Means	38.979	10.93	9.88	4.17	1.71	1.36	71.95
Foreign corn:							
Maxima	*e* 46.487	*f* 12.60	*g* 11.55	*e* 4.85	*f* 2.20	*g* 1.80	*e* 71.85
Minima	*f* 18.428	*e* 10.43	*e* 9.80	*f* 4.02	*e* 1.57	*f* 1.26	*g* 68.02
Means	28.553	11.71	10.72	4.51	1.87	1.54	69.65
Means of samples from the United States exhibited at the Columbian Exposition (18 analyses)	38.979	10.93	9.88	4.17	1.71	1.36	71.95
Means of foreign samples exhibited at the Columbian Exposition (2 analyses)	28.553	11.71	10.72	4.51	1.87	1.54	69.65
Means of former analyses of the Department of Agriculture:	(*h*)	(*j*)	(*i*)	(*j*)	(*j*)	(*i*)	(*j*)
United States	36.474	10.04	10.39	5.20	2.09	1.55	70.69
Northern States	37.320	9.98	10.64	5.11	1.41	1.54	71.32
Southern States	40.659	8.96	10.95	4.94	1.72	1.37	72.06
Middle West	32.457	12.33	10.89	4.97	2.22	1.43	68.16
Far West	37.528	9.50	10.43	5.30	2.47	1.55	70.75
Pacific Slope	27.900	9.78	8.14	6.40	2.07	1.48	72.13
Jenkins and Winton (208 analyses)		10.90	10.50	5.40	2.10	1.50	69.60
König—Mean composition of samples from various localities:							
Miscellaneous origin (137)		13.35	9.45	4.29	2.29	1.29	69.33
Italian samples (24)		13.13	10.26	3.84	2.88	1.95	67.72
American samples (80)		10.02	10.17	4.78	1.67	1.40	68.63
Dent corn (149)		10.14	9.36	4.96	2.21	1.47	68.65
Sugar corn (27)		8.70	11.43	7.79	2.86	1.81	62.76
Southeastern Europe (19)		14.53	9.42	4.13	2.34	1.39	69.37
Southwestern Europe (8)		12.47	8.84	5.80	4.16	2.06	65.79

a Kentucky.
b Indiana.
c Wisconsin
d New Hampshire.
e New South Wales.
Bulgaria.
j 114 analyses,
g Argentine Republic.
h 1211 analyses.
i 202 analyses.

Comparing the means of the analyses of American samples with those of foreign origin, we are again struck with the excess of moisture in the foreign samples. In those from southwestern Europe are found 4 per cent more moisture than in samples of domestic origin. Among the samples grown in the United States, those in the Middle West, viz, Iowa, Missouri, Nebraska, etc., contain the largest amount of moisture, while those grown in the arid region have the smallest amount. Of the domestic samples exhibited at the World's Fair it was found that the mean content of water was 10.93 per cent, nearly 1 per cent higher than the mean of former analyses of the Department. The weight of 100 kernels was a little more than that before found, and this is not a surprising fact, inasmuch as it would be natural for exhibitors to send not only the largest ears but also the largest grains to the Exposition. The percentage of albuminoids in the domestic World's Fair samples was surprisingly low, being about 0.75 per cent less than was found in the work done a few years ago. On the other hand, the percentage of digestible carbohydrates was about one point higher than that obtained in the former work. In the above table will be found a convenient comparison of the means of maize analyses from all parts of the world.

The typical American maize should have approximately the following composition: Weight of 100 kernels, 38 grams; moisture, 10.75 per cent; albuminoids, 10 per cent; oil, 4.25 per cent; fiber, 1.75 per cent; ash, 1.50 per cent; digestible carbohydrates, 71.75 per cent.

OATS.

In the United States, oats are used chiefly for cattle food, and the amount devoted to the manufacture of oatmeal is small compared to the total production. For this reason it seemed advisable to make the analyses on the unhulled samples. The high percentage of crude fiber and ash, therefore, which is found in the analytical tables is due to the fact that the hull was ground with the grain. Former investigations of the Department, recorded in Bulletin No. 9, show that the proportion of kernel to the husk for the United States is as 7 to 3. In the Western States the proportion of kernel is relatively higher and in the Southern States relatively lower. One hundred samples of the hulls of oats, representing all parts of the United States, were found to have the following composition:

	Per cent.
Water	5.22
Ash	5.59
Soluble carbohydrates and undetermined	68.83
Indigestible fiber	17.88
Albuminoids	2.48

Taking this average composition of the hulls and the proportion of kernel to husk as the basis of computation, it will be possible to calculate the average results for each locality in terms of the kernel alone.

In the following table are contained the results of the analyses of the World's Fair samples arranged by States and foreign countries:

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		COLORADO.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1969	16	I. S. McClelland, Fort Collins	Black Tartarian	40	38	2.586	8.23	12.08	4.22	12.19	4.08	59.20
1973	17	D. C. Travis, San Isabel	World's Wonder	136	35	3.462	8	12.43	4.24	15.73	4.11	55.49
		Means				3.024	8.12	12.26	4.23	13.96	4.09	57.34
		ILLINOIS.										
9666	39	T. P. Chester, Champaign	Russian oats	73.5		2.448	11.01	11.90	3.29	12.75	3.62	57.43
9668	40	do	White Chief	67	40	2.570	10.93	11.20	3.67	12	3.80	58.40
9669	41	do	White Bonanza	71	40	2.433	9.58	10.68	3.46	15.85	3.36	57.07
9670	42	do	Black Tartarian	70	38.50	2.038	9.19	12.78	3.48	13.90	4.20	56.45
9706	9	University of Illinois, Champaign	Wide Awake oats	44	42	2.950	9.26	14.53	3.78	12.96	2.92	56.55
9713	10	do	Pride of Grant County	61	39	2.724	8.14	12.78	4.10	11.46	3.67	59.85
17787	11	Robert Sheddon, Pingree Grove	Black Highlands			2.722	8.95	9.63	4.02	12.93	3.73	60.74
17788	12	do	Race Horse White	64	53	2.993	9.60	14.18	3.94	12.26	2.87	57.15
17792	13	do	Prize Chester	56	46	3.302	9.54	10.15	5.09	11.06	2.72	61.44
17793	14	do	Black Tartarian	48	38.50	2.659	9.75	9.10	4.03	13.03	3.77	60.32
		Means				2.684	9.59	11.69	3.89	12.82	3.47	58.54
		INDIANA.										
8570	34	F. C. Huntington, Indianapolis	W. Scotch Superior	70	56	2.751	9.33	12.43	4.10	13.75	3	57.39
8571	35	John Marvel, Indianapolis	White Belgian	60	40	2.526	9.07	12.78	4.44	13.75	2.92	57.04
8573	36	Ellis Burke, Crawfordsville	Prize Cluster	50	40	2.829	8.69	12 78	4.28	13.97	3.01	57.27
8723	37	Indiana Experiment Station, Lafayette	White Bonanza	38	45	2.780	9.05	13.30	4.19	14.62	2.99	55.85
8729	38	do	American Banner	43	38	2.475	10.04	12.25	3.27	14.15	3.85	56.44
		Means				2.672	9.24	12.71	4.06	14.05	3.15	56.79
		IOWA.										
3470	8	L. G. Clute & Sons, Greeley	Badger Queen	67	44	3.255	8.30	10.68	4.44	15.23	3.81	57.54
		KANSAS.										
88	44	H. W. Hoffman, Salina	Black oats	62	40	2.783	11.46	11.55	5.57	8.62	2.91	59.89
89	43	A. C. Rait, Junction City	Red oats	54	38	3.415	9.61	13.48	4.82	8.57	3.71	59.81
90	45	N. J. Dalton, Topeka	do	58	37	2.934	11	10.85	4.95	12.10	3.99	57.11
91	46	Thos. Anderson, Salina	Black oats	35	40	2.323	10.84	11.90	6	8.82	3.72	58.72
94	47	W. S. Lower, Halton	Red oats			3.810	9.12	12.17	4.72	11.30	4	58.69

Description and analyses of oats—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		KANSAS—continued.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
95	48	F. Fry, Salina	Red oats			3.194	10.61	12.69	5.08	10.07	4.03	57.52
96	1	James Sullivan, Salina	Black oats	50	39	2.385	9.80	13.13	5.66	8.71	3.60	59.10
97	2	J. R. Knox, Manhattan	Red oats	60	39	2.877	9.11	12.08	4.10	13.78	3.67	57.26
98	3	W. G. Swift, Clay Center	Black oats	55	40	2.075	9.15	13.48	6.14	8.90	3.70	58.63
99	4	L. Laudren, Russell	White oats	48	39	3.075	9.68	15.05	4.07	10.20	3.62	57.38
100	49	Erick Uriburg, Clay Center	Red oats	60	38	3.054	11.70	11.73	5.28	9	3.97	58.32
		Means				2.920	10.19	12.55	5.12	10.01	3.72	58.40
		KENTUCKY.										
1250	27	C. B. Eaton, Winchester	White			2.327	10.83	11.38	4.03	11.97	4.20	57.59
1190	26	Kentucky Agricultural Experiment Station, Lexington.	Badger Queen			2.095	10.96	11.64	4.66	11.52	3.80	57.42
1194	5	do	Golden Giant		42	2.116	8.77	13.48	4.13	13.32	3.18	57.12
1195	6	do	Welcomer oats			2.479	8.85	11.73	4.60	12.57	3.24	59.01
		Means				2.254	9.85	12.06	4.35	12.35	3.60	57.78
		MICHIGAN.										
21247	66	David Woodman, Paw Paw	White Russian	45	40	3.294	11.63	12.25	4.15	12.35	2.86	56.76
21250	60	do	Common White oats	54	40	3.410	11.42	12.78	4.07	12.32	2.77	56.64
21273	57	do	Dakota oats	50	40	3.306	11.13	12.78	4.06	12	2.89	57.14
21287	69	do	Potato oats	60	33.50	2.516	12.75	14	3.66	12.45	2.14	53.70
21294	62	do	Common White oats	60	42	3.352	10.20	12.95	4.76	11.65	2.86	57.58
		Means				3.176	11.43	12.95	4.14	12.25	2.90	56.36
		OHIO.										
11111	67	Eli Culbertson, Grand Rapids	Monarch	58		2.620	11.17	12.25	4.15	13.50	3.24	55.69
11117	64	Thos. Crofts, Toledo	Early Prize Cluster	60	34	2.197	7.87	13.65	4.10	12.50	3.06	58.82
		Means				2.405	9.52	12.95	4.13	13	3.15	57.26
		PENNSYLVANIA.										
2890	28	Samuel Wilson, Mechanicsville	White Bonanza	68.5	40	2.613	10.75	14.36	3.88	13.64	3.46	53.91
6468	29	Michael Gibson, Mansfield	Oats			2.530	11.17	11.90	3.38	12.82	3.03	57.70
6470	30	W. H. Harnish, Waterstreet	do	40	37	2.606	11.05	12.25	3.77	12.17	3.42	57.34

6471	31	Peter Hoffmann, Scalpnel	do	40	40	2.249	10.33	11.90	4.35	11.25	2.94	59.23
6479	7	M. M. Naginey, Milroy	do			2.564	8.15	12.08	3.65	13.43	2.94	59.75
6480	32	W. H. Nesbit, Milton	do	50	41	2.974	9.51	12.25	4.51	12.80	2.47	58.46
		Means				2.589	10.16	12.46	3.92	12.68	3.04	57.73
		WASHINGTON.										
a 13925	54	W. O. Bush, Olympia	White Wonder	50 to 100	35 to 45	3.891	13.02	11.03		(*b*)	3.18	
13928	59	do	Elsmore	50 to 100	35 to 45	3.811	10.82	11.03	.93	16.65	2.78	57.79
		WISCONSIN.										
15536	70	A. Guster, Beaver Dam	White oats			2.843	11.65	10.68	4.27	11.17	3.15	59.08
		WYOMING.										
14066	56	Wyoming Experiment Farm, Lander	American Banner	46		3.435	11.05	10.15	4.94	10.75	4.37	58.74
14068	68	W. A. Sonnesberger, Buffalo	Black Russian	68	38.50	2.359	10.97	10.33	4.91	9.37	3.92	60.50
14069	52	do	Bonanza	96	43.50	3.526	10.59	11.90	4.59	12.75	3.91	56.26
14072	50	Wyoming Experiment Farm, Laramie	Early Archangel	26	44	2.938	11.57	10.77	4.99	9.37	3.75	59.55
14074	63	A. A. Lambrigger, Big Horn	Golden Giant	100	42	3.231	9.82	12.60	5.01	9.87	4.	58.70
a 14082	61	do	Race Horse	80	45	3.742	10.86	11.55		(*b*)	3.53	
14086	55	Wyoming Experiment Farm, Lander	White Russian	65	41	3.282	11.23	10.50	5.66	9.07	3.83	59.71
14088	53	A. A. Lambrigger, Big Horn	White Wonder	60	45	3.470	10.50	12.60	4.29	11.17	3.65	57.79
		Means				3.248	10.82	11.26	4.91	10.33	3.92	58.75
		Total means, United States				2.918	10.06	12.15	4.33	12.07	3.46	57.93
		CANADA.										
7802	15	Ontario Agricultural College, Guelph, Ontario.	Rennie's Prize White oats			3.871	9.27	11.73	4.09	13.48	2.95	58.48
8423	18	I. E. Richardson, Blenheim	Challenge White oats	50		3.390	9.43	11.47	4.36	13	2.86	58.88
8431	19	Gaylord Greenman, Charlotteville	Black Tartarian	50		2.791	9.21	11.73	5.56	8.60	2.92	61.98
8433	20	I. E. Richardson, Blenheim	White oats	60		3.750	9.20	10.68	4.29	13.89	3.29	58.65
8434	21	Richard P. Wilson, Trafalgar	Black Tartarian	70		3.076	9.87	11.55	5.49	8.52	3.22	61.35
8437	22	George Baker, Woodhouse	White Walker	65		3.278	8.83	11.38	3.93	14.25	3.16	58.45
8445	23	A. G. Meisner, Gainesborough, Ontario	White oats	55		2.912	8.55	12.08	4.07	13.36	2.99	59.04
8446	24	George Baker, Woodhouse	do	60		3.092	8.52	11.20	3.79	15.65	3.23	57.61
8452	25	George Padget, Markham, Ontario	Renney Selected White	50		4.253	9.21	12.25	4.90	11.62	2.71	59.31
8471	33	D. Alton, McDonald	White oats			3.698	10.16	12.78	4.27	12.27	2.87	57.65
12250	71	I. Wilson, Fergas, Ontario	Oats and pease mixed				9.65	14.18	6.63	1.12	1.94	66.48
30136	51	W. Wanman, Souris, Manitoba	White oats	55		2.895	11.63	11.03	4.96	11	2.97	58.41
		Means				3.364	9.46	11.83	4.73	11.39	2.92	59.69
		GREAT BRITAIN.										
26583	65	Kean, Robinson & Belleville, London	Oats			3.242	10.29	10.68	6.21	9.40	2.75	60.67
		Total means, foreign oats				3.354	9.52	11.75	4.84	11.24	2.91	59.76
		Total means, all oats				2.995	9.96	12.07	4.42	11.92	3.35	58.28

a Nos. 13925 and 14082 excluded from the means.

b Sample lost.

NOTES ON ANALYSES OF OATS.

For comparing the results of these analyses with those heretofore made by this Department and in other places the table of maxima, minima, and means is inserted below.

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
Domestic oats:	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Maxima	*a* 3.891	*a* 13.02	*b* 15.95	*b* 6.14	*a* 16.65	*c* 4.37	*d* 61.44
Minima	*d* 2.038	*e* 7.87	*d* 9.10	*a* .93	*b* 8.57	*f* 2.47	*g* 53.70
Means	2.918	10.06	12.15	4.33	12.07	3.46	58.75
Canada:							
Maxima	4.253	11.63	12.78	5.56	15.65	3.29	61.98
Minima	2.791	8.52	10.68	3.79	8.52	2.71	57.61
Means	3.364	9.46	11.83	4.73	11.39	2.92	59.69
Means of World's Fair samples (72 analyses)	2.995	9.96	12.07	4.42	11.92	3.35	58.28
Means of samples previously analyzed by Department of Agriculture—hulled—(179 analyses)	*h* 2.507	6.93	14.31	8.14	1.38	2.15	67.09
Means of Jenkins and Winton (30 analyses)		11	11.80	5	9.50	3	59.70
König—mean composition of samples from various localities:							
Miscellaneous (377)		12.11	10.66	4.99	10.58	3.29	58.37
Middle and north Germany (31)		12.45	10.82	5.30	10.25	3.29	58.23
Southern and southwestern Germany (16)		13.39	11.36	5.30	9.93	3.18	58.12
Austro-Hungary (14)		11.85	11.41	5.84	11.01	3.23	56.40
France (196)		13.50	9.52	3.46	9.18	3.26	62.47
United States (22)		12.11	10.11	6.24	9.33	2.99	68.61

a Washington. *b* Kansas. *c* Wyoming. *d* Illinois. *e* Ohio. *f* Pennsylvania. *g* Michigan. *h* Unhulled.

In discussing the comparative results contained in the above table, it will be noticed at once that the samples examined at the World's Fair contained much less water than those reported by König. These samples were almost wholly of domestic origin, and thus show that the oats follow the other cereals which have been mentioned in having a less quantity of moisture when grown in the United States. The percentage of indigestible fiber also appears to be somewhat larger than of other sets of samples. This may be due to the fact that naturally the largest and finest looking kernels would be selected for exhibition and the hulls of these kernels would be correspondingly developed. In the samples formerly examined by the Department of Agriculture we find the same striking deficit in moisture that has been noticed in the other cereals and the consequent increase in the percentage of other constituents, notably albuminoids and oil. It must not be forgotten, however, that these samples can not be compared with the other sets in the series, because the hulls of the kernels were removed before the analyses were made. Taking into consideration all the data at hand, it may be said that the typical oats of the United States may be described as follows: One hundred kernels of the unhulled oats will weigh 3 grams and will consist of 2.1 grams kernels and 0.9 gram hulls. The sample would contain in its normal state 10 per cent of water, 12 per cent of albumi-

noid matters, 4.5 per cent of fat, 12 per cent of indigestible fiber, 3.5 per cent of ash, and 58 per cent of starch and other soluble carbohydrates.

RICE.

It is rather difficult from the data accessible to draw any valuable conclusions in regard to the composition of rice. This cereal may reach the analyst in three different states, viz, unhulled, hulled, and polished. He may also have occasion to examine the broken fragments produced in polishing and hulling, the waste in manufacture, rice bran, and other products. The most important of these products are the unhulled and polished rice—in the one case the product as it comes from the thrasher and in the other as prepared for the kitchen.

The number of samples of all kinds delivered by the judges for analysis was only 28, of which only a few were domestic samples. The composition of these samples, arranged by classes and countries, is shown in the table on the following page.

Description and analyses of rice.

I. RICE IN THE HULL.

Bureau of awards No.	Laboratory No.	Grower.	Foreign or domestic.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
					Bushels.	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
17825	24	Robert Shedden, Pingree Grove, Ill..	Domestic.....	Upland rice.....			2.782	11.48	6.83	1.48	9.82	4.02	66.37
22231	26	Antonio Lapollen, Santa Rosa, Suchitepequez, Guatemala.	Foreign.....				2.845	9.03	8.23	1.64	10.95	4.45	65.70
22232	25	Taribas de Leon, Santa Isabella, Suchitepequez, Guatemala.	do				3.250	9.10	8.32	1.44	11.47	4.66	65.01
		Means.....					3.048	9.07	8.28	1.54	11.21	4.56	65.35
29561 A	23	Government of Johore, Johore.....	Foreign.....	Galak cleaned rice in hulls.			2.842	11.52	8.40	2.04	9.45	3.26	65.33
		Means of foreign rice.....					2.979	9.88	8.32	1.71	10.62	4.12	65.35
		Means of all rice.....					2.929	10.28	7.95	1.65	10.42	4.09	65.60

II. UNPOLISHED RICE.

9105	1	Issei Nagano, Kumamoto, Japan.....	Foreign.....		40 to 52		2.446	12.57	7.27	1.75	0.90	1.16	76.25
9107	2	Tsumki Tuchinoye, Kumamoto, Japan.	do				2.826	12.22	7.35	1.62	.90	1.21	76.67
9108	3	Kan Gijokai, Kumamoto, Japan.....	do				2.389	11.67	7.53	1.90	.92	1.22	76.76
9413	12	Tahei Watanabe, Ehime, Japan.....	do				2.598	10.92	7.53	2.04	1	1.17	77.34
9416	13	J. Ishiuri, Toyamaken, Japan.....	do				2.277	12.02	7.92	2.18	.87	1.10	75.91
9479	14	Shosuke Sato, Hokkaido, Japan.....	do		38.50		2.260	11.88	10.50	2.26	.97	1.04	73.35
		Means.....					2.466	11.88	8.02	1.96	.93	1.15	76.05

III. POLISHED RICE.

17286	15	State of Louisiana, Baton Rouge, La.	Domestic				1.906	12.20	9.45	0.10	0.40	0.33	77.52
30578	19	Georges Ioroukoff, Novo Selo, Bulgaria.	Foreign		50 to 55		2.214	13	7.18	.24	.40	.57	78.61
22236	20	Manuel Depaz, Chiquililla, Guatemala.	do				1.560	12.01	8.58	.11	.27	.41	78.62
22237	21	Antonio Lapollen, Santa Rosa, Sachitepequez, Guatemala.	do				2.461	12.30	9.28	.27	.56	.65	76.95
		Means					2.010	12.15	8.93	.17	.42	.53	77.79
9150	4	Shigaken Beishitsu Kainjokumiae Farishimarijo, Shiga, Japan.	Foreign		40 to 52		2.314	12.65	5.95	.18	.27	.31	80.64
9152	5	Koki Houma, Yamagata, Japan	do				1.673	12.15	5.78	.48	.50	.44	80.65
9154	6	Kuhei Igarashi, Yamagata, Japan	do				1.889	11.82	5.42	.11	.35	.64	81.66
9158	7	Kishinoruke Sato, Akita, Japan	do		40 to 55		2.138	11.94	6.30	.49	.37	.56	80.34
9390	8	Ryoyei Kabushiki Kwaisha, Hyogo, Japan.	do				2.342	11.97	6.30	.07	.40	.28	80.98
9398	9	Nippon Seimai Kwaisha, Hyogo, Japan.	do				2.229	12.39	5.78	.54	.42	.46	80.41
9399	10	do	do				2.243	12.28	5.95	.04	.42	.35	80.96
9408	11	Okayama Seimaijo, Okayama, Japan	do				2.395	12.21	5.95	.12	.36	.31	81.04
		Means					2.153	12.18	5.93	.25	.39	.42	80.83
29561	23	Government of Johore, Johore	Foreign	Galak cleaned rice			1.858	13.15	8.23	.47	.52	.53	77.10
29574	22	do	do	Java rice			2.633	12.67	10.33	.44	.40	.54	75.62
		Means					2.246	12.91	9.28	.46	.46	.53	76.36
		Means of foreign polished rice					2.149	12.35	7	.27	.40	.46	79.51
		Means of all polished rice					2.132	12.34	7.18	.26	.40	.46	79.36

IV. RICE BRAN.

17288	17	State of Louisiana, Baton Rouge, La.	Domestic				10.77	11.12	1.96	10.72	8.55	56.88

As in the case of the preceding cereals, it will be of interest here to compare the mean results of the analyses carried on with the World's Fair samples with those on record in other places. In the case of the World's Fair samples, the maxima and minima as well as the means are given as before, while in other cases only the means are recorded.

Table of maxima, minima, and means.

RICE.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
I. Rice in the hull (foreign):	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Maxima	a 3.250	b 11.52	b 8.40	b 2.04	b 11.47	a 4.66	a 65.70
Minima	b 2.842	a 9.03	a 8.23	a 1.44	b 9.45	b 3.26	a 65.01
Means	2.979	9.88	8.32	1.71	10.62	4.12	65.35
II. Unpolished rice (foreign):							
Maxima	c 2.826	c 12.57	c 10.50	c 2.26	c 1	c 1.22	c 77.34
Minima	c 2.260	c 10.92	c 7.27	c 1.62	c .87	c 1.04	c 73.35
Means	2.466	11.88	8.02	1.96	.93	1.15	76.05
III. Polished rice (foreign):							
Maxima	b 2.633	b 13.15	b 10.33	c .54	a .56	a .65	c 81.66
Minima	a 1.560	c 11.82	c 5.42	c .04	a .27	c .28	b 75.62
Means	2.132	12.34	7.18	.26	.40	.46	79.36
Mean composition of polished rice, etc., as given by Jenkins and Winton:							
Polished rice (10 samples)		12.40	7.40	.40	.20	.40	79.20
Rice bran (5 samples)		9.70	12.10	10.90	9.50	10	49.90
Rice hulls (3 samples)		8.20	3.60	.70	35.70	13.20	38.60
Rice polish (4 samples)		10	11.70	7.30	6.30	6.70	58
Mean composition of rice, etc., as given by König:							
Unhulled rice (3 samples)		11.99	6.48	1.65	6.48	3.33	70.07
Hulled rice (41 samples)		12.58	6.73	1.88	1.53	.82	76.46
Polished rice (9 samples)		12.52	7.52	.84	.48	.64	78
Means of World's Fair samples:							
Unhulled rice (4 samples)	2.929	10.28	7.95	1.65	10.42	4.09	65.60
Unpolished rice (6 samples)	2.466	11.88	8.02	1.96	.93	1.15	76.05
Polished rice (14 samples)	2.132	12.34	7.18	.26	.40	.46	79.36

a Guatemala. *b* Johore. *c* Japan.

The mean composition of the different classes of rice as shown by the analyses of the World's Fair samples is almost the same as that shown by the work of other analysts collated as indicated above. A typical unhulled rice will have about the following composition:

Weight of 100 kernels	grams	3.00
Moisture	per cent	10.50
Albuminoids	do	7.50
Fat	do	1.60
Fiber	do	9
Ash	do	4
Carbohydrates	do	67.40

A typical hulled rice, but unpolished, would have about the following composition:

Weight of 100 kernels	grams	2.50
Moisture	per cent	12
Albuminoids	do	8
Fat	do	2
Fiber	do	1
Ash	do	1
Carbohydrates	do	76

A typical polished rice would have a composition represented by the following numbers:

Weight of 100 kernels	grams	2.20
Moisture	per cent	12.40
Albuminoids	do	7.50
Fat	do	.40
Fiber	do	.40
Ash	do	.50
Carbohydrates	do	78.80

RYE.

The number of samples of domestic rye offered for examination and analysis was 18, and of foreign ryes, 2. The samples offered were presumably the best that came into the hands of the judges as far as could be determined by external appearance. Their composition, as revealed by the chemical analysis, is given in the following table:

Description and analyses of rye.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
		ILLINOIS.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
9671	20	T. P. Chester, Champaign	White rye	32	52	1.932	11.05	11.55	1.68	2.15	1.71	71.86
9672	21	do	Giant rye	32	52	2.408	10.89	11.55	1.44	2.45	1.80	71.87
9749	4	O. L. Campbell, Knoxville	White rye			1.992	12	11.90	1.59	1.77	1.88	70.86
17820	5	Robert Sheddon, Pingree Grove	Dusburg rye			3.600	11.19	18.99	2.15	1.65	2.41	63.61
17822	7	do	White Spring rye	30	58	4.201	9.54	17.77	1.16	2.12	1.99	67.42
17823	6	do	St. John's rye	27	58	2.472	11.45	13.13	1.42	2.17	1.93	69.90
		Means				2.767	11.02	14.15	1.57	2.05	1.95	69.25
		MICHIGAN.										
20502	22	A. C. Titus, Fitchburg				2.215	10.38	12.60	1.51	2.15	1.90	71.49
		MINNESOTA.										
2331	14	Peter Anderson, Foldal	White rye	30	56	2.224	10.13	13.13	1.79	2.27	1.90	70.78
2382	15	Francis Dick, Afton	Winter rye	30		2.177	9.91	13.65	2.11	2.32	1.91	70.10
2446	16	Wm. Reuhter, Red Wing	White Winter rye	56	57.50	2.289	10.35	13.65	1.56	2.25	1.81	70.38
2458	17	Thos. Sanders, Warren	do			2.234	10.25	13.30	1.61	2.42	1.99	70.43
		Means				2.231	10.16	13.43	1.77	2.32	1.90	70.42
		NEW HAMPSHIRE.										
379	1	Edwin T. Evans, Rochester	Winter rye	26	(*a*)	2.442	10	11.03	1.58	2.50	2.09	72.80
380	23	Merrill Moore, Northfield	Rye	22	60	2.528	10.26	11.47	1.28	2	1.99	73
382	2	C. W. T. Spiller, Pittsfield	Winter rye	25	60	2.022	9.77	9.80	1.69	1.75	1.80	75.19
		Means				2.331	10.01	10.77	1.52	2.08	1.96	73.66
		NEW YORK.										
4216	10	John W. Jones, Elmira	White Winter	28	62.25	2.841	11.05	9.98	1.50	1.65	1.88	73.94
4241	11	Alexander B. Stewart, Ballston Center	Black Winter			2.247	10.50	10.68	2.30	2.10	1.89	72.53
		Means				2.544	10.78	10.33	1.90	1.88	1.89	73.24
		OREGON.										
3259	8	M. Wilkins, Coburg	White rye			2.829	10.81	8.40	1.65	1.97	1.81	75.36

		PENNSYLVANIA.										
2893	19	Samuel Wilson, Mechanicsville	Pennsylvania Mammoth White.	38.50	60	2.232	11.10	11.20	1.65	1.97	1.96	73.12
		Total means, United States				2.493	10.62	12.43	1.65	2.09	1.92	71.37
		BRAZIL.										
28245	26	Comm. Mines, Ouro Preto	Rye			2.031	14.10	12.25	.37	2.25	1.95	69.08
		SPAIN.										
30499	25	Giraldo Cerespo (Eusebio), Medina del Campo.	Rye			3.417	10.74	9.28	1.61	1.75	1.88	74.74
		Total means, foreign rye				2.724	12.42	10.77	.99	2	1.92	71.91
		Total means, all rye				2.516	10.77	12.26	1.58	2.08	1.92	71.42

a Over standard.

For a comparison, the data collected by former analyses of the Department, and in the works already noted, follow:

Table of maxima, minima, and means.

RYE.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.
Domestic:	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Maxima	*a* 4.201	*a* 11.45	*a* 18.99	*b* 2.30	*c* 2.50	*a* 2.41	*d* 75.36
Minima	*a* 1.932	*a* 9.54	*d* 8.40	*a* 1.16	*a* 1.65	*a* 1.71	*a* 63.61
Means	2.493	10.62	12.43	1.65	2.09	1.92	71.37
Foreign:							
Maxima	*e* 3.417	*f* 14.10	*f* 12.25	*e* 1.61	*f* 2.25	*f* 1.95	*e* 74.74
Minima	*f* 2.031	*e* 10.74	*e* 9.28	*f* .37	*e* 1.75	*e* 1.88	*f* 69.08
Means	2.724	12.42	10.77	.99	2	1.92	71.91
Means of World's Fair samples:							
Domestic samples (18)	2.493	10.62	12.43	1.65	2.09	1.92	71.37
All samples (20)	2.516	10.77	12.26	1.58	2.08	1.92	71.42
Means of previous analyses by the Department (57 samples)	2.070	8.67	11.32	1.94	1.46	2.09	74.52
Means given by Jenkins and Winton (6 samples)		11.60	10.60	1.70	1.70	1.90	72.50
Means given by König:							
Miscellaneous (173)		11.15	10.81	1.77	1.78	2.06	70.21
Spring rye (11)		12	12.90	1.98	1.71	1.93	68.11
North Germany (27)		14.84	11.01	1.70	2.17	1.97	69.78
South Germany (36)		12.31	12.04	1.98	2.73	1.91	67.97
Sweden (3)		14.29	8.50	2.29	1.47	2.11	71.34
All Germany (63)		13.37	11.52	1.84	2.45	1.94	68.88

a Illinois. *b* New York. *c* New Hampshire. *d* Oregon. *e* Spain. *f* Brazil.

We see again, in the comparison of the means, the greater dryness of the United States ryes. This is, as has been the case heretofore in the cereals already mentioned, especially marked in the analyses made a few years ago by the Department. In the World's Fair samples the difference is less marked, the percentage of moisture being almost as high as in the foreign samples.

The United States ryes are also distinguished by their smaller kernels. Even the samples on exhibition in Chicago, which were presumably those of the finest and plumpest kernels, were not nearly so large as the kernels of the foreign samples. They were, however, distinctly larger and heavier than the kernels analyzed here a few years ago.

In the percentage of albuminoids the United States samples are fully equivalent to those of foreign origin and in their mean composition their other constituents do not differ greatly from those of standard varieties abroad. The cultivation of rye is not very extensively practiced in the United States and that which is grown is used chiefly for the manufacture of whisky and for cattle food, and not for bread making, as is the case in Europe.

A typical American rye would have approximately the following composition: Weight of 100 kernels, 2.5 grams; moisture, 10.50 per cent; albuminoids, 12.25 per cent; oil, 1.50 per cent; fiber, 2.10 per cent; ash, 1.90 per cent; digestible carbohydrates, 71.75 per cent.

WHEAT.

The number of samples of domestic wheat submitted for examination by the judges of awards was 166. These samples were distributed among the various States, as follows:

Colorado, 5 samples; Illinois, 22 samples; Indiana, 8 samples; Iowa, 1 sample; Kansas, 28 samples; Kentucky, 4 samples; Maine. 1 sample; Michigan, 6 samples; Missouri, 1 sample; Montana, 2 samples; Nebraska, 5 samples; New York, 8 samples; North Carolina, 2 samples; Ohio, 3 samples; Oregon, 11 samples; Pennsylvania, 12 samples; South Dakota, 8 samples; Washington, 11 samples; West Virginia, 5 samples; Wisconsin, 5 samples; Wyoming, 7 samples.

Of foreign wheats the total number of samples offered for examination was 62. These samples were distributed as follows:

Argentine Republic, 5 samples; Australia, 4 samples; Bulgaria, 1 sample; Canada, 49 samples; Costa Rica, 2 samples; Spain, 1 sample.

The results of the analyses are recorded in the following tables:

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.	Wet gluten.	Dry gluten.
		COLORADO.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1948	45	T. L. Trasey, Hygiene	Polish	35	60	5.419	10.15	15.23	1.67	2.62	1.97	68.36	33.04	12.95
1950	46	D. Leathene, Lamar	Red Chaff	25	61	2.519	9.66	12.78	2.11	2.95	2	70.50	27.73	10.70
1953	48	I. S. McClelland, Fort Collins	Australian Club	22	60	5.190	9.67	12.08	1.91	2.67	1.87	71.80	27.01	10.53
1955	49	Sylvester & Son, Monte Vista	Ruby No. 16	30	60	5.103	9.71	14.35	1.73	2.72	1.94	69.55	31.92	12.17
1957	50	I. S. McClelland, Fort Collins	Saxon Fife			3.280	8.13	13.83	2.26	2.75	1.82	71.21	31.61	11.93
		Means				4.302	9.46	13.65	1.94	2.74	1.92	70.28	30.26	11.66
		ILLINOIS.												
9698	12	University of Illinois, Champaign.	Dietz Long Bearded Red	30	55	3.048	11.84	13.65	1.66	2.67	2.03	68.15	31.67	12.45
13447	192	Robert Shedden, Pingree Grove.	Champion White Winter, No. 1.	49	62	4.539	8.64	10.50	1.95	1.87	1.75	75.30	25.54	10.10
13448	189	do	Imperial White Winter	63	62.75	4.727	10.35	11.03	1.66	2.12	1.81	73.03	22.61	9.02
17669	13	do	Prince Champion	43	63	5.537	12	11.03	1.59	2.19	1.62	71.57	24.33	9.57
17670	14	do	Hardcastle	42	64	4.680	11.53	10.50	1.85	2.25	1.72	72.15	22.40	8.88
17673	15	 do	Pride of the Market	56	64	4.195	12.22	10.85	1.79	2.80	1.67	70.69	23.41	9.32
17678	16	do	Scottish Chief Red	55.50	64	3.958	12.72	10.68	1.80	2.92	1.78	70.70	23.45	9.32
17679	17	do	Flour Ball	63.50	64	5.703	12.68	11.38	1.58	2.25	1.70	70.41	25.43	9.78
17691	151	do	Ontario Red	57	65.50	4.909	9.93	11.03	1.50	2.05	1.71	73.78	22.26	8.63
17695	158	do	Prolific	36	62	4.380	13	12.95	1.59	2.72	1.85	67.89	28.23	10.78
17703	152	do	Pride of the Market	56	60	4.262	9.71	10.85	1.66	2.07	1.77	73.94	21.72	8.65
17704	153	do	Jones Winter Fife	40	62	4.542	8.66	11.20	1.54	2.02	1.88	74.70	20.55	8.32
17705	154	do	Holborn Wonder	53	60	4.113	8.47	11.73	1.24	2.05	1.71	74.80	21.80	10.61
17707	155	do	Prize Champion			4.380	8.19	11.38	1.90	2.20	1.84	74.49	23.65	9.20
17708	156	do	Red River Club	38	61	2.571	7.97	15.93	2.09	3.15	2.16	68.69	32.11	12.75
17715	157	do	French Imperial	35	60	2.125	7.95	13.13	2.08	2.97	2.06	71.81	25.05	10.08
17718	41	do	Kissingland Red	58	62.50	4.435	9.57	11.20	1.67	2.35	1.75	73.46	23.21	9.23
17727	42	do	Japan Amber	33.50	63	3.717	9.60	11.90	1.70	2.50	1.43	72.87	27.77	10.39
17730	43	do	Marcian Bronze	32	63	4.404	9.18	13.30	1.65	3	2.02	70.85	27.35	10.51
10760	159	do	Red Prize Spring	40	68	4.544	12.76	11.20	1.52	2	1.73	70.79	23.38	9.44
10765	160	do	Redgreen S	43	65	4.467	12.85	11.20	1.59	2.37	1.79	70.20	16.68	6.55
10766	161	do	Square Head	40	68	4.377	13.06	12.25	1.54	2.62	1.86	68.67	24.34	9.69
		Mean				4.255	10.59	11.76	1.69	2.39	1.80	71.77	24.40	9.69

		INDIANA.												
8523	130	James Riley, Thorntown	Pool	30	60	3.450	11.25	10.85	1.97	2.17	1.87	71.92	22.80	8.75
8525	131	J. N. Barker, Thorntown	E. R. Clawson	38	58.50	4.285	10.78	12.25	1.56	2.47	1.78	71.16	26.36	10.15
8532	132	James Riley, Thorntown	Surprise	40	61	3.302	10.38	11.73	1.87	2.55	1.86	71.61	27.35	10.59
8553	85	John Blair, Peru	Fultz	25	60	2.828	10.90	11.90	1.52	2.25	1.85	71.58	27.18	10.61
8557	53	James Riley, Thorntown	Filse Clawson	40	60	3.637	10.74	12.43	1.83	2.10	1.83	71.07	27.30	10.47
8559	54	do	Dial Mediterranean	40	61	4.186	13.10	14.18	1.44	2.37	1.76	67.15	27.51	10.85
8561	55	Mrs. S. Hodges, Rockport	E. R. Clawson	40	60.50	3.844	10.17	12.08	1.68	2.45	1.81	71.81	24.06	9.47
8677	134	James Riley, Thorntown	American Bronze	36	59	3.908	12.16	11.03	1.83	3.05	1.79	70.14	24.78	9.46
		Means				3.680	11.19	12.05	1.71	2.42	1.82	70.81	25.92	10.04
		IOWA.												
3098	185	L. G. Clute, Greeley, Iowa	White and Red Spring	32	61.25	3.874	11.90	16.01	1.77	2.20	1.45	66.67	33.44	13.80
		KANSAS.												
1	162	A. Shrieve, Wamego, Kans	Red Winter	42.50	63	3.504	13.02	14.18	1.59	2.57	1.70	66.94	33.25	12.20
2	175	L. Landon, Russell, Kans	Hard Winter	18.50		2.965	7.75	13.30	1.84	2.25	1.81	73.05	30.98	11.55
3	176	N. I. Dalton, Topeka, Kans	Red Winter	30	63	3.472	8.96	12.95	1.52	2.87	1.94	71.96	30.80	11.28
5	177	Cyrus Wray, Salina, Kans	do	36	62.75	3.374	8.95	12.43	1.91	2.22	1.99	72.50	28.14	11.20
6	74	G. B. Donmeyer, Cambria, Kans	do	42.75	63	3.821	9.49	12.43	1.84	2.32	1.91	72.01	30.40	11.34
7	170	H. W. Hoffman, Salina, Kans	do	36	63	3.127	10.09	11.55	1.87	2.07	1.69	72.73	27.20	9.87
8	163	W. S. Lowe, Halton, Kans	Hard Winter	39.50	61.50	4.446	12.75	12.95	1.60	1.70	1.82	69.18	29.30	10.55
9	178	S. H. Cramer, Ottawa, Kans	Red Winter	42.50	65	3.308	9.23	12.25	1.62	2.62	2.10	72.78	28.25	11.01
10	75	I. H. Sayles, Norcatur, Kans	do	45	62.75	3.252	10.86	10.50	1.82	2.12	2.02	72.68	22.36	8.45
11	179	G. Y. Johnson, Willis, Kans	Hard Winter	42.17	62	3.624	8.85	12.78	1.69	2.20	2.04	72.44	30.64	11.71
12	164	P. E. Butler, Glasco, Kans	Red Winter	34	61.50	4.408	8.81	11.73	1.89	2.55	1.96	73.06	30.80	11.15
13	165	B. D. French, Concordia, Kans	do	38	61	3.323	9.03	11.55	2.26	2.30	1.95	72.91	26.30	10.49
14	166	Wm. Rundell, Clay Centre, Kans	do	35	62.50	3.270	8.51	14	1.81	3.12	1.95	70.61	32.82	12.35
16	180	W. W. Eddie, Marysville, Kans	do	33	63	3.585	8.47	14.18	1.91	2.25	1.97	71.22	31.85	12.24
17	167	A. Anderson, Marysville, Kans	Hard Winter	38	61.50	3.081	7.97	11.73	2.02	2.35	1.91	74.02	26.88	9.94
18	181	I. L. Johnson, Marysville, Kans	do	30	63	3.305	7.78	10.85	1.55	2.42	1.96	75.44	22.87	9.02
19	182	Gottlieb Adam, Marysville, Kans.	Red Winter	40	61	3.732	9.44	11.90		2.12	2		29	11.36
20	183	Frank de Long, Bellveille, Kans	Hard Winter	(a)	(b)	3.649	9.38	11.55	1.70	2.20	1.84	73.33	23.17	9.34
21	1	A. C. Rait, Junction City, Kans.	Red Winter	38	61.50	3.337	12.18	11.21	1.27	2.40	2.05	70.89	21.86	8.72
22	2	W. H. Smille, Topeka, Kans	do	38	62.50	3.311								
23	3	Thos. Gillespie, Salina, Kans	do	39	63.25	3.046	12.58	11.20	1.54	2.25	1.93	70.50	23.45	9.11
24	4	S. T. Collins, Belleville, Kans	Hard Winter	38	63	3.088	12.05	10.85	1.74	3.12	1.86	70.38	21.11	8.39
25	5	H. A. Houston, Junction City, Kans.	do	40	63	3.245	12.12	12.50	1.69	2.67	1.77	69.25	29.61	11.11
26	6	John Luster, Linn, Kans	Red Winter	32.50	64	3.191	14.53	11.90	1.73	2.50	1.80	67.54	28.25	10.43
27	7	I. K. Edwards, Phillipsburg, Kans,	Hard Winter	43	63.25	3.389	11.59	11.20	1.61	2.32	1.91	71.37	22.63	8.58
28	8	I. D. Foster, Washington, Kans	do	33	65	3.238	12.06	11.55	1.52	2.62	1 61	70.66	24.20	9.54
29	9	S. B. Wilson, Clay Center, Kans	do	36.25	62.50	3.135	12.23	12.78	1.74	2.42	2	68.81	31.50	11.85
63	169	E. E. Ross, Menoken, Kans	Red Winter in Straw			3.450	7.11	11.90	1.80	2.37	1.93	74.88	25.10	9.68
		Means				3.381	10.21	12.15	1.64	2.41	1.91	71.68	27.51	10.46

a Average standard. *b* Up to standard.

Description and analyses of wheat—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.	Wet gluten.	Dry gluten.
		KENTUCKY.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1054	33	I. F. Garnett, Casky, Ky	Lizzie Williams	30	62	4.085	10.07	12.95	1.90	2.33	1.82	70.93	27.54	11.37
1055	34	E. B. Lyle, Churchill Ky	Fulcaster			3.913	10.71	14.53	1.48	2.44	1.69	69.15	23.98	9.59
1073	10	W. B. Rout, Sonora, Ky	Improved Fultz	30	60	3.699	12.46	11.38	1.79	2.25	1.61	70.51	22.02	8.67
1078	11	B. S. Clarkson, Big Spring	Longberry wheat			3.382	12.45	13.83	1.67	2.60	1.85	67.60	33.18	12.75
		Means				3.019	11.42	13.17	1.71	2.41	1.74	69.55	26.68	10.59
		MAINE.												
16699	103	B. F. Willey, Cherryfield, Me	Defiance	25	65	3.532	9.45	13.13	1.85	2.25	1.90	71.42	30.90	11.95
		MICHIGAN.												
20436	109	A. J. Hodgers, Jonesville, Mich	Golden Cross		61	3.718	10.87	10.50	1.47	2.30	1.87	72.99	22.20	8.65
20457	110	I. P. Curtin, Ovid, Mich	White Clawson	36	61	4.004	10.98	11.73	1.60	2.37	2.02	71.30	24.01	9.21
20462	250	I. C. Bosabeck, Eaton Rapids, Mich.	Diehl Mediterranean	25	64	4.155	12.25	12.08	2.18	2.17	1.77	69.55	20.05	8.10
20483	112	G. H. Cannan, Porterville	Fultz		62	3.325	11.10	11.55	1.78	2.50	1.71	71.36	25.03	9.88
20759	173	Agricultural College, Lansing	Rural No. 5			3.992	8.07	11.03	1.78	2.25	1.83	75.04	24.90	9 67
21086	222	David Woodman, Paw Paw, Mich.	Square Head	37	61	4.186	10.61	11.73	1.87	2.25	1.89	71.65	24.88	9.50
		Means				3.897	10.65	11.44	1.78	2.31	1.85	71.98	23.51	9.17
		MISSOURI.												
13684	92	Missouri Agricultural College, Columbia.	Fultz	35.30		3.844	11.50	12.25	1.75	2.10	1.94	70.46	29.13	11.33
		MONTANA.												
14443	93	L. M. Davis, Missoula, Mont	Hard Fife	60	63	2.448	9.84	13.30	2.25	2.75	2.13	69.72	29.02	11.35
14450	249	D. C. O'Keefe, Missoula, Mont	Blue Flint	64	62	3.269	12.41	13.13	2.20	2.22	1.86	68.18	27.67	11.47
		Means				3.359	11.13	13.21	2.23	2.48	1.99	68.95	28.35	11.41
		NEBRASKA.												
20131	104	L. M. Myers, Cheyenne County, Nebr.	Spring White Russian	26	60.50	2.772	9.91	12.95	2	2.77	2.05	70.32	32.57	12.48
20132	105	W. S. Delano, Lees Park, Nebr	Scotch Fife Springs	24	60	2.848	9.14	17.15	2.16	2.77	2.05	66.73	39.05	14.65

20133	106	I. B. Stewart, Benedict, Nebr.	Turkey (fine color) Red	53	62	3.128	9.35	12.43	1.62	2.50	1.70	72.40	32.80	12.25
20134	107	I. Copsey, Westerville, Nebr	Winter	35		3.560	11.36	11.55	1.83	2.87	2.08	70.31	24.36	9.35
20138	108	I. N. Stewart, Broken Bow, Nebr.	Velvet Chaff, spring wheat.	26	60	2.559	11.80	15.23	1.94	3.22	1.76	76.05	33.68	13.08
		Means				2.973	10.31	13.86	1.91	2.83	1.93	71.16	32.57	12.36
		NEW YORK.												
3700	237	P. Henderson & Co., New York.	Jones Square Head			3.441	12.49	10.85	1.78	2.25	1.17	71.46	14.09	5.49
3853	211	S. D. Howell, Millville	Clawson	32	61	4.765	9.07	14.53	1.97	2.20	1.90	70.33	34.31	13.33
3876	225	James H. Gray, Lima	do	32	61.50	3.652	10.30	12.60	2.05	1.92	1.52	71.61	25.91	9.95
3885	204	J. G. Billinger, Herkimer	White China	30	62	4.317	9.66	13.65	1.76	2.15	1.83	70.95	30.23	12.02
3892	223	Chas. H. Tuttle, Clockville	Red Hybrid	20	61	3.744	10.96	14.70	1.91	2.25	1 30	68.88	32.51	12.81
3961	205	J. E. Didama, Medina	Brown's Amber	38	62	4.253	9.19	9.98	1.99	1.92	1.78	75.14	19.63	7.46
3963	197	N. G. Coon, Medina	do	35	62	3.959	10.20	9.98	1.86	1.87	1.93	74.16	17.22	6.94
3982	194	A. Horning, Phelps	Lancaster Amber	35	62	4.325	11.15	12.43	2	2	1.91	70.51	24.98	9.98
		Means				4.057	10.38	12.34	1.92	2.07	1.67	71.63	27.36	9.69
		NORTH CAROLINA.												
10010	67	N. H. Gwynn	Fulcaster	30		4.987	12.05	11.73	1.77	2.40	1.81	70.24	26.34	10.18
10014	68	B. H. Oliver, Salisbury	White wheat			3.966	12.59	11.12	1.63	2.30	1.80	70.56	21.98	8.63
		Means				4.477	12.32	11.43	1.70	2.35	1.81	70.40	24.16	9.41
		OHIO.												
11059	216	Albert Neifer, Weston, Ohio	White Fultz			4.516	11.83	10.33	1.79	2.10	1.75	72.21	17.81	6.99
11071	195	Whipps Bros., Marion, Ohio	Negro wheat		61	3.947	9.71	11.73	1.89	2.10	2	72.57	24.03	9.77
11078	203	Joseph Culbertson, Grand Rapids, Ohio.	Yellow Gypsy	30		3.946	9.47	11.20	1.87	2.32	1.80	73.34	24.35	9.62
		Means				3.803	10.34	11.08	1.85	2.17	1.85	72.71	22.06	8.79
		OREGON.												
3201	119	M. Wilkins, Coburg	Centennial	35	61	4.096	10.03	9.98	1.87	2.37	1.94	73.81	24.23	9.06
3206	120	do	Orlena White Chaff	45	63	4.482	10.37	7.88	2.12	2.17	1.65	75.77	17.34	6.10
3279	242	Geo. Bolshaw, Eugene	White Winter	45	63	4.898	10.90	9.63	1.99	2.15	1.67	73.66	12.33	4.70
3280	240	do	English Spring	45	63	4.067	10.95	8.93	1.99	2.25	1.78	74.10	12.80	5.10
3285	241	do	Michigan Winter	45	63	4.497	10.90	9.63	2.13	2.27	1.67	73.40	18.52	7.42
3287	239	do	Fish Pole No. 1	45	63	4.529	11.76	9.63	1.68	2.32	1.61	73	16.20	6.40
3319	121	do	Scotch Fife	45	63	4.617	11.44	8.75	1.72	2.50	1.80	73.79	12.96	5.13
3321	76	do	do	45		4.561	11.25	8.58	1.71	2.17	1.88	74.41	16.11	6.09
19268	56	John Allison, Hopewell	Red or Kinney	40	62.50	5.368	12.54	8.93	1.62	2.12	1.40	73.39	17.09	6.69
19269	57	Hamilton & Roork, Pendleton	Chile Club	45	62	4.536	13.91	10.50	.28	2.37	1.63	71.31	22.06	8.19
19270	58	W. S. Simeral, Macleary	White Winter	45	61	4.724	12.77	8.75	1.85	2.12	1.48	73.03	14.53	5.58
		Means				4.579	11.53	9.19	1.72	2.25	1.69	73.61	16.74	6.41

Description and analyses of wheat—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract	Crude fiber.	Ash.	Carbohydrates.	Wet gluten.	Dry gluten.
		PENNSYLVANIA.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
2934	118	Samuel Wilson, Mechanicsville, Pa.	Red Wonder	47	61	4.968	11.85	11.55	1.79	2.35	1.80	70.66	25.32	9.88
6518	35	Allegheny County Home, Woodsville, Pa.				3.200	12.14	11.38	1.82	3	1.95	69.71	31.01	12.26
6520	36	W. C. Blackfan, New Hope, Pa.		28	62	3.700	11.70	13.65	1.72	2.75	1.72	68.46	28.62	11.32
6521	37	Thomas Baker, Octoran, Pa.				3.797	12.01	12.60	1.82	2.23	1.74	69.60	26.18	10.72
6523	38	S. H. Bennison, Abdera, Pa.		24.50	64	3.979	10.72	13.13	1.84	2.07	1.95	70.29	27.45	10.82
6527	39	Ed. K. Bohr, Robesonia, Pa.	No. 1 Long	42	61	3.364	11.60	12.78	1.85	3.72	2.06	67.99	30.45	11.50
6527	40	do	Red Winter	35	63	4.059	16.65	15.40	2.50	2.57	2.06	66.82	35.03	13.78
6561	51	Jordon Bros., Federal, Pa.	Federal	24	(*a*)	3.719	9.23	14	1.79	2	2	70.98	28.40	10.88
6565	52	W. J. Martin, Cattawissa, Pa.				4.331	9.03	12.95	1.67	2.22	1.61	72.52	28.17	10.82
6583	80	Wm. Shannafelt, Brinkerton, Pa.		20	64	4.069	11.49	14.18	1.80	2.17	1.97	68.39	32.08	11.80
6586	81	State College, Bellefonte, Pa.	Fulcaster	16 to 26	62.50	4.080	10.60	12.78	1.85	2.27	2.19	70.31	34.13	12.74
6588	82	E. A. Thompson, Beech Cliff, Pa.		18	60	3.536	11.98	11.38	1.67	2.10	1.87	71	27.49	10.40
		Means				3.903	11.08	12.98	1.84	2.45	1.91	69.73	29.57	11.41
		SOUTH DAKOTA.												
6632	206	T. Lacey, Sioux Falls	Blue Stem			3.485	8.92	15.49	1.89	2.55	1.61	69.54	35.71	13.69
6633	196	N. Hartman, Mount Vernon	do			3.064	8.76	14.88	2.17	2.60	1.81	69.78	32.19	12.94
6636	207	M. Hutgen, Tyndall	do	40		2.958	8.81	14.35	2.21	2.37	2.06	70.23	29.84	11.91
6637	190	J. M. Johnson, Mitchell	do			3.571	8.85	15.75	1.96	2.75	1.67	69.02	22.61	12.87
6638	193	A. Maloney, Orland	do			3.591	9.29	15.75	1.93	2.35	1.60	69.08	33.02	13.13
6640	201	W. Lewis, Sioux Falls	do	38	60	3.353	8.88	13.65	2.09	2.59	1.64	71.18	29.44	11.68
6641	227	S. Thorsen, Canton	do	39	60	3.493	10.10	15.58	1.90	2.32	1.54	69.56	30.95	12
6643	198	C. Bullock, Brookings	do	35	60	3.179	8.56	13.65	2.18	2.40	1.70	71.51	28.24	11.42
		Means				3.337	9.02	14.89	2.04	2.49	1.70	69.89	30.25	13.71
		WASHINGTON.												
12710	135	The State of Washington, Olympia, Wash.	Chile Club	38	62.25	3.765	11.62	9.63	.48	2.60	1.86	73.81	20.46	7.37
12711	90	do	Pride of Butt			4.818	11.11	10.15	1.74	2.10	1.95	72.95	21.61	8.32
12737	136	do	Blues Stem Winter	41	61.25	4.572	10.03	13.48	1.72	2.32	1.70	70.75	33.76	12.02
12798	199	do	Red Chaff		30 to 60	3.896	12.34	8.75	1.75	2.02	1.97	73.17	17.05	6.81
13960	137	W. O. Bush, Olympia, Wash	Surveil	30 to 60	62	5.858	10.57	11.55	1.53	2.00	1.88	72.47	26.44	9.79
13965	138	do	Little Club	30 to 60		4.225	9.94	10.15	1.86	2.27	1.92	73.86	23.63	8.78
13973	139	do	California Pringle	30 to 60		5.783	9.37	11.38	1.84	2.37	1.77	73.27	23.88	9.19
13983	140	do	Gilback	30 to 60		4.081	10.34	9.98	1.84	2.30	1.71	73.83	22.36	8.16

13984	141	do	Republic or Surprise	30 to 60		5.533	9.76	10.85	2	2.22	1.73	73.44	24.28	8.13
13986	142	do	Tutts	30 to 60		5.810	9.31	10.50	1.84	2.42	1.81	74.12	22.35	8.76
13990	143	do	Blue Stem	30 to 60		4.427	10.62	10.85	1.83	2.74	1.79	72.17	19.40	7.30
		Means				4.787	10.46	10.66	1.67	2.31	1.83	73.08	23.20	8.59
		WEST VIRGINIA.												
14944	144	W. W. Foreman, West Liberty, W. Va.	Early Fultz	25	63.25	3.115	10.90	12.60	1.71	2.07	1.79	70.93	28.98	10.78
14944	94	do	do	25	63.25	3.179	10.10	12.95	1.83	2.12	1.82	71.18	28.33	11.33
14956	96	W. Hogg, Short Creek, W. Va	Pool	35	63.25	4.030	9.91	14	1.90	2.10	1.91	70.18	32.44	12.48
14967	97	I.M. Sydenstricker, Lewisburg, W. Va.	Russian	28	62	4.214	11.46	13.65	2	2.45	1.85	68.65	31.99	12.99
14979	219	M.V.Small, Martinsburg, W. Va.	Fulcaster	25	63	4.042	12.20	13.30	1.73	2.27	1.87	68.63	28.37	11.15
		Means				3.716	10.90	13.30	1.83	2.20	1.85	69.92	30.02	11.75
		WISCONSIN.												
15407	147	M. Cashman, Hudson, Wis	Blue Stem			3.108	9.65	12.78	2.19	2.70	1.64	71.04	25.39	10.00
15438	148	Charles Dahms, Shawano	Russian Spring	25	60	3.620	9.25	15.75	2	2.12	1.96	68.92	33	13.26
15447	149	Thomas Davis, Oshkosh	White Winter	30	61.50	3.269	9.84	12.25	1.92	2.45	1.97	71.57	26.88	10.49
15482	150	Arthur B. Ewing, Sylvan	Fultz	20	62	3.005	11.85	13.30	1.84	2.37	1.93	68.71	29.24	11.08
15547	98	Ernest Gollneck, Cedarburg	White Winter	30	60.50	4.220	10.64	10.68	1.56	2.45	1.68	72.99	23.56	9.34
15585	212	W. Harland, Duplainville	Red Winter	42	62.50	3.349	9.20	12.25	1.93	2.12	1.75	72.75	27.75	10.87
15776	218	Fred Muehl, Seymour	Blue Stem	25	62.50	3.672	11.09	13.13	1.60	2.07	1.86	70.25	29.89	11.61
15945	202	I. M. Shoff, Easton	Swamp Red Winter	25		2.795	9.77	14	1.77	2.32	1.89	70.25	19.27	11.55
15960	99	George Snyder, Oconomowoc	Red Winter	25	63	3.704	12.53	13.83	1.55	2.20	1.86	68.03	33.83	12.40
15991	100	Anton Stumpleshorst, Gravesville.	Blue Stem Red Winter	26	63.50	3.615	12.37	12.95	1.78	2.20	1.91	68.79	30.08	11.88
16042	101	Moses Walker, Berlin	Fultz Red Winter	40	62.50	3.531	10.95	12.60	1.68	2.40	1.72	70.65	27.34	10.51
16046	102	Ely Walter, Neenah	Clawson White	26	61.25	4.242	10.20	10.68	1.88	2.25	1.64	73.35	23.35	8.91
16066	186	Caleb Wells, Milton	Red Winter	40	63.75	3.601	11.25	11.90	1.60	2.05	1.70	71.50	24.77	9.35
16105	188	Eliza T. Wilson, Amy	do	25	64	3.498	11.09	11.90	1.68	2	1.84	71.49	28.10	10.89
16113	187	Thomas Wishart, De Pere	do	28	63.25	3.526	10.52	12.43	1.65	2.27	1.75	71.38	30.21	11.62
16115	184	Carl Wittkopf, Plymouth	do	22	64.50	3.566	11.44	15.31	1.65	2.07	1.80	67.73	35.35	14.27
		Means				3.519	10.73	12.85	1.77	2.25	1.81	70.58	28	11.13
		WYOMING.												
14017	210	Experiment Farm, Lander	Winter Fultz			3.538	8.46	11.73	1.81	2.25	1.91	73.84	27.40	10.44
14026	220	do	Red May Winter			3.445	10.81	12.78	1.96	2.15	1.41	71.09	30.01	11.46
14028	244	William Brown, Sheridan	Saskatchewan Fife	45	62	3.720	9.83	14.35	2.35	2.67	1.81	68.99	30.80	12.10
b14035	245	Peter George, La Prille	White Colorado			3.314	14.13	11.03		2.17	1.83		24.95	9.16
14037	246	Experiment Farm, Lander	Touse			4.686	12.92	9.45	1.38	2.15	1.95	72.15	21.50	7.80
14038	247	A. A. Larnbrigger, Big Horn	Amber Spring	45	65	6.190	10.71	14.88	2.40	1.97	1.75	68.29	37.35	14.45
14039	248	do	Big Horn	60	62	5.137	13.40	12.78	1.57	2.25	2.35	67.65	27.69	10.69
		Means				4.290	10.99	12.66	1.91	2.24	1.86	70.34	28.54	10.87
		Total means, United States				3.866	10.62	12.23	1.77	2.36	1.82	71.18	26.46	10.31

a Above standard.

b No. 14035 excluded from means.

Description and analyses of wheat—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.	Wet gluten.	Dry gluten.
		ARGENTINE REPUBLIC.		*Bushels.*	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
23301	234	Jose Doriga, Buenos Ayres	Hard Red	28.67	63	2.761	12.33	14.26	1.62	2.87	1.91	67.01	30.87	12.30
23601	214	N. Olivan, Buenos Ayres	Wheat			3.542	9	12.08	2.07	2.17	2.04	72.64	27.25	10.80
23603	213	Miguel S. Onetto, Buenos Ayres	No. 1, Hard Red	64	32.50	3.368	8.52	12.95	2.26	2.80	1.95	71.52	28.58	11.57
23806	209	Eduardo Thorney, Buenos Ayres	Wheat	30.25	61.50	3.372	8.90	14.53	1.68	2.89	2.02	69.98	29.46	11.76
23823	215	Udarritta, Buenos Ayres	do	31	61	2.520	9	10.08	1.58	2.70	2.04	74.60	27.98	11.49
		Means				3.113	9.55	12.78	1.84	2.69	1.99	71.15	28.83	11.58
		AUSTRALIA.												
5578	77	J. Black & Sons, Mouma, New South Wales.	Purple Straw	35	66.50	5.478	12.97	8.58	.73	1.87	1.82	74.03	18.72	7
5580	174	George Clout, Brungle, New South Wales.	Steinwedel	25	67.75	5.723	8.70	9.63	1.78	1.97	1.78	76.14	21.90	8.11
5586	78	New South Wales World's Fair Commissioners, Sydney, Australia.	Sanmers de Mars	30	65	5.258	12.68	9.45	1.80	2.25	1.68	72.14	21	8.06
5594	79	Pawley & McIntyre, Imerell, Australia.	White Tuscan	43	63.50	5.415	11.81	8.75	1.89	2.07	2.01	73.47	20.94	8.33
		Means				5.468	11.54	9.10	1.55	2.04	1.82	73.94	20.64	7.88
		BULGARIA.												
30566	228	Georges Ivanoff, Dich-Boudac		30 to 50	60 to 63	4.696	12.40	11.55	1.52	1.95	1.67	70.91	29.10	7.97
		CANADA.												
8029	122	Jos. Brethour, Burford	Russian Spring	25	62	5.270	11.15	11.73	1.71	2.62	1.79	71	26.60	10.14
8032	123	Henry Grout, Townsend	Red Clawson	33		4.044	10.12	11.20	1.92	2.35	1.76	72.65	22.82	8.77
8034	124	Andrew Turnbull, North Dumfries.	Surprise	33	62	5.335	10.58	8.23	2.04	2.12	1.67	75.36	19.53	2.80
8036	83	J. E. Richardson, Burford	Golden Cross	29		4.857	11.11	9.80	1.77	2.17	1.88	73.27	20.86	8.10
8072	84	Thomas Puzey, Woodhouse	Red Manchester	30	61	4.687	10.46	9.98	1.96	2.40	1.93	73.28	22.91	8.72
8127	18	Thomas Elmes, Burford	White Winter			4.376	11.75	9.80	1.73	2.57	1.70	72.45	19.16	7.50
8132	19	Robert Walker, Ancaster	American Bronze	40	61	4.389	12.75	10.50	1.59	2.50	1.70	70.95	20.17	8.14
8133	20	F. Lloyd Jones, Burford	White Clawson Fall	45	61	4.803	12.15	10.50	1.68	2.35	1.82	71.50	21.23	8.18
8134	21	do	Rio Grande Spring	36	61	3.276	12.27	11.38	1.99	2.77	2	69.59	22.25	9.14
8141	22	John A. Smith, Charlotteville	Golden Cross Fall	30	60	4.100	10.87	9.80	1.83	2.21	1.87	73.42	21.85	4.99
8144	23	James Brethour, Burford	Wild Goose	30		4.655	12.17	13.48	2.32	2.17	1.93	67.93	32.56	13.09

8147	24	Richard Wilson, Townsend	Surprise Winter	35	60	4.421	11.76	9.63	1.74	2.19	1.83	72.85	15.09	5.66
8219	126	Andrew Clifford, St. Joseph Island.	Red Fern			3.567	11.15	10.50	2.20	2.50	1.72	71.93	22.84	9.18
8222	127	J. T. Talman, Saltfleet	Clawson White Winter			4.743	11.64	9.28	1.76	2.12	1.66	73.54	18.54	7.08
8233	128	John W. Clark, Saltfleet	do			4.673	11.92	9.28	1.76	2.15	1.73	73.16	14.04	5.42
8241	129	William Tuck, Nelson	Zerewa White Winter			4.459	11.47	8.40	1.88	2.05	1.75	74.45	14.27	5.35
8404	59	John C. Shaw, Woodburne	Surprise			4.107	11.95	8.58	1.95	2.05	1.60	73.97	6.38	2.29
8410	60	D. Burt, St. George	Red Clawson	35 to 40	62	4.981	10	11.64	1.98	2.12	1.84	72.42	23.91	9.56
8415	62	Wm. Pennock, South Crosby	McCarling	35		5.144	12.10	12.43	2.06	2.30	1.96	69.15	25.21	10.08
8417	63	Major Walker, Ancaster	American Bronze			4.198	11.95	9.45	1.89	2.10	1.81	72.80	18.12	6.85
8420	64	T. Manderson, Reach	White Fife			4.429	11.24	12.95	2.08	2.20	1.76	69.77	27.37	11.20
8422	65	J. E. Richardson, Princeton	Spring	29		3.827	13.98	9.45	.41	2.12	1.60	72.44	19.84	6.62
9029	44	Government of Manitoba, Winnipeg.	Red Fife			3.452	10.56	15.05	1.99	3.12	1.45	67.83	33.28	13.47
12549	86	Northwest Territories Government, Regina.	Hard Red Fife	30 to 35	62 to 65.50	4.105	11.30	15.84	1.86	2	1.74	67.26	37.11	14.40
12555	87	do	White Fife	30	65.50	3.791	11.50	15.05	1.66	2.07	1.50	67.22	35.87	13.86
12576	88	do	Wheat in Straw			4.181	12.30	11.90	1.99	2.25	1.80	69.76	22.83	9.13
19204	217	A. N. Morden, Pincher Creek		53.50	65.50	3.672	10.07	16.10	1.92	2	1.47	68.44	38.94	15.24
24532	233	Price Ellison, Vernon	Colorado Spring Wheat	40	62	4.411	11.47	12.08	1.87	2.60	1.88	70.19	31.87	12.18
24534	232	D. G. Gummongs, Spalumcheen, British Columbia.	Cambell's White Chaff Spring.	47.50	62	4.100	11.50	12.08	1.69	2.50	1.87	70.36	29.75	11.25
24535	231	D. Matherson, Spalumcheen	Red Fife	48.30	62	4.052	10.77	13.65	2.27	2.10	1.86	69.35	31.99	12.76
24536	230	Earl of Aberdeen, Spalumcheen, British Columbia.	Cambell's White Chaff Spring.	40	61	4.197	12.03	11.73	1.70	2	1.88	70.66	27.29	10.40
24540	229	W. H. Landoner, Landoners	Ladoga	40	61.50	4.118	11.63	15.23	1.77	2.05	1.72	67.60	30.59	12.17
27744	69	T. Manderson, Reach	Standard White	35	61	4.294	13.80	9.11	1.79	2.25	1.56	71.49	18.67	7.54
27745	70	Wm. Tuck, Watertown	Zerewa White	54	60	4.478	12.65	8.58	1.82	2.12	1.75	73.08	12.34	4.79
27752	71	Wm. Pennock, South Crosby	White Fife Spring	35	61	3.899	11.36	13.48	1.96	2.30	1.82	69.28	26.97	10.83
27753	72	J. S. Pearce, London, Ontario	White Russian Spring	32		3.891	11.29	14.18	1.45	2.32	1.72	69.04	27.91	10.88
30074	226	Northwest Territories Government, Winnipeg.	Ladoga	34.50	63	3.362	9.38	13.30	1.97	2.17	1.42	71.76	29.11	11.45
30075	224	do	White Fife	35	62	3.976	11.09	15.23	1.91	2	1.51	68.26	32.75	13.39
30076	264	do	Red Fife	32	62	4.085	12.91	15.58	1.51	2.15	1.93	65.92	24.54	10.09
	265					3.951	12.90	13.48	1.70	2.37	1.63	67.92	33.13	13.15
	266					3.447	12.53	14.44	1.70	2.27	1.63	67.43	27.20	11.30
30139	255	W. Sandy, Thornhill	White Fife	41	63	3.450	11.98	13.91	1.79	2.40	1.48	68.44	20.77	8
30140	256	W. A. Kilkenney, Broomhill	Red Fife	28	63	3.389	12.08	15.05	1.60	2.10	1.38	67.79	28.11	11.43
30141	257	W. J. Benny, Eden	do	40	61	613.376	11.93	15.40	1.86	2.37	1.41	67.03	28.24	11.69
30142	258	E. and A. Melon, Portage La Prairie.	do	39	64	643.113	12.73	13.30	1.92	2.42	1.54	68.09	32.32	13.24
30143	259	W. Foxwell, Brandon	do	27	64	3.412	12.17	14.70	1.88	2.10	1.44	67.71	24.03	9.83
30145	260	R. H. Honeyman, Eden	do	29	64	3.242	12.23	14.97	1.85	2.35	1.61	66.99	30.25	12.30
30146	261	William Hope, Carberry	do	29	64.75	3.259	12.10	14.70	1.82	2.25	1.44	67.69	29.35	12.05
30148	262	M. Morrison, Greswold	White Fife	31	65	3.380	12.05	14.53	1.89	1.75	1.50	68.28	30.37	12.60
		Means				4.052	11.69	12.25	1.80	2.26	1.69	70.31	25.13	9.76

Description and analyses of wheat—Continued.

Bureau of awards No.	Laboratory No.	Grower.	Variety.	Yield per acre.	Weight per bushel.	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.	Wet gluten.	Dry gluten.
		COSTA RICA.												
				Bushels.	*Pounds.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
29720	252	Canton de Paraiso, Cartago		25 to 40	61.50	3.228	12.15	11.90	1.60	2.52	1.73	70.10	27.93	11.11
29721	253	Canton de Paraiso, Heredia		25 to 40	63.50	3.367	9.33	12.34	1.78	2.35	1.84	72.36	24.69	9.77
		Means				3.298	10.74	12.12	1.69	2.44	1.78	71.23	26.31	10.44
		SPAIN.												
30475	235	Giraldo Crespo, Medina del Campo.	Wheat			5.446	10.50	12.60	1.80	2.42	2.01	70.67	32.57	12.33
		Means, foreign wheat				4.076	11.47	12.08	1.78	2.28	1.73	70.66	25.36	9.82
		Total means, all wheat				3.940	10.85	12.20	1.74	2.35	1.81	71.05	26.28	10.22

Among domestic samples the largest and finest kernels were found in a sample from Wyoming. One hundred kernels weighed 6.19 grams, or one-fifth of an ounce. The smallest kernels were in a sample from Illinois. The sample containing the most moisture, strange as it may appear, was from Kansas, and likewise the driest sample. In regard to albuminoids, Nebraska leads with a sample containing 17.15 per cent, and Oregon has the smallest portion in any sample, namely, 8.58 per cent. In respect of moist and dry gluten, the Nebraska sample showed the largest percentages, namely, 39.05 and 14.65, respectively, and Oregon furnished a sample showing the smallest percentages, namely, 12.33 and 4.70, respectively.

In the Canadian samples, the one having the largest kernels gave a weight of 5.335 grams, and the one having the smallest, of 3.242 grams per hundred kernels, respectively. In albuminoids the extremes were 16.10 and 8.23 per cent, respectively; in moisture, 13.98 and 9.38 per cent, respectively; in moist gluten, 38.94 and 6.38 per cent, respectively, and in dry gluten, 15.24 and 2.29 per cent, respectively.

Of the other foreign wheats, Australia furnished the sample having the largest kernels, namely, 5.723 grams per hundred. The smallest grains were from the Argentine Republic, namely, 2.920 grams per hundred.

The sample containing the largest percentage of moisture, namely, 12.97, was from Australia, and the one containing the smallest percentage, namely, 8.52, from the Argentine Republic.

In albuminoids, a sample from the Argentine Republic takes the lead with a percentage of 14.53, while a sample from Australia shows the smallest amount, namely, 8.58 per cent.

In moist gluten, a sample from Spain gave the largest amount, namely, 32.57 per cent, and one from Australia the smallest, namely, 18.72 per cent. Spain and Australia also afforded the maximum and minimum percentages of dry gluten, namely, 12.33 and 7 per cent, respectively.

For convenience of comparison, the following table of maxima, minima, and means of the Worlds' Fair samples, compared with the means given by the previous work of the Department and by other authorities is inserted.

Table of maxima, minima, and means.

	Weight of 100 kernels.	Moisture.	Albuminoids.	Ether extract.	Crude fiber.	Ash.	Carbohydrates.	Wet gluten.	Dry gluten.
Domestic:	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Maxima	a 6.190	b 14.53	c 17.15	d 2.50	d 3.72	a 2.35	c 76.05	c 39.05	c 14.65
Minima	e 2.125	b 7.11	f 8.58	f .28	b 1.70	f 1.40	g 66.67	f 12.33	f 4.70
Means	3.866	10.62	12.23	1.77	2.36	1.82	71.18	26.46	10.31
Canada:									
Maxima	5.335	13.98	16.10	2.32	3.12	2	75.36	38.94	15.24
Minima	3.242	9.38	8.23	.41	1.75	1.38	65.92	6.38	2.29
Means	4.054	11.69	12.25	1.80	2.26	1.69	70.31	25.13	9.76
Foreign:									
Maxima	h 5.723	h 12.97	i 14.52	i 2.26	i 2.89	i 2.04	h 76.14	j 32.57	j 12.32
Minima	i 2.250	i 8.52	h 8.58	h .73	h 1.87	k 1.67	i 67.01	h 18.72	h 7
Means	4.076	11.47	12.08	1.78	2.28	1.73	70.66	25.36	9.82
Means of World's Fair samples:									
Domestic samples (165)	3.866	10.62	12.23	1.77	2.36	1.82	71.24	26.46	10.31
Canadian samples (62)	4.054	11.69	12.25	1.80	2.26	1.69	70.31	25.13	9.76
All foreign samples (62)	4.076	11.47	12.08	1.78	2.28	1.73	70.66	25.36	9.82
All samples (227)	3.940	10.85	12.20	1.74	2.35	1.81	71.09	26.28	10.22
Means of previous analyses by the Department:									
Domestic (147)	3.653	9.97	10.53			2.06			
United States and British America (407)	3.644	10.16	12.15			1.92			
Colorado (155)	4.235	7.54	12.54	2.29	1.64	1.82	74.17	33.80	11.07
Means given by Jenkins and Winton:									
Spring (13)		10.40	12.50	2.20	1.80	1.90	71.20		
Winter (262)		10.50	11.80	2.10	1.80	1.80	72		
Means given by König:									
Samples of miscellaneous origin (428)		13.37	12.51	1.70	2.56	1.79	68.01		
Samples from northeast and middle Germany (90)		14.01	10.93	1.65	2.12	1.92	70.01		
Samples spring wheat (81)		14.75	11.23	2.03	2.26	2.52	68.61		
Samples from south and west Germany (52)		13.18	12.29	1.71	2.82	1.85	67.96		
Samples spring wheat (30)		13.80	14.95	1.56		2.19	67.93		
Samples from Austro-Hungary (18)		11.72	12.66	1.99	3.39	1.75	66.84		
Samples from Russia—spring wheat (39)		12.65	17.65	1.58		1.66	65.74		
England (22)		13.41	10.99	1.86	2.90	1.67	69.21		
Scotland (16)		11.37	10.58	1.73		1.55	72.77		
France (70)		15.20	12.64	1.41	2	1.66	68.92		
Denmark (4)		13.95	9.36	2.34	2.19	1.34	71.40		
Spain (9)		13.37	12.45	1.92		1.80			
Africa (34)		11.80	11.18	1.83	1.82	1.76	70.04		
Asia (8)		12.57	11.09	2.10	1.94	1.46	70.84		
Australia (4)		13.37	10.16	1.39			b		
North America (504)		9.92	11.60	2.07	1.70	1.79	69.47		
North America—spring (40)		9.36	12.92	2.15	1.72	1.86	67.98		

a Wyoming.
b Kansas.
c Nebraska.
d Pennsylvania.
e Illinois.
f Oregon.
g Iowa.
h Australia.
i Argentine Republic.
j Spain.
k Bulgaria.

In the means taken from König as given above the amount of water as found is given.
The means of the other constituents, however, in order to secure a proper comparision are calculated on the supposition that the mean content of water is the same as that in the chief or miscellaneous table, namely, 13.37 per cent.

In the discussion of the comparative results, it will be noticed first, as with other cereals, that the content of moisture in the domestic samples is low, being about 1 per cent less than in the Canadian samples and eight-tenths of 1 per cent less than in all the foreign samples. This remarkable dryness of cereal products appears, therefore, to be a characteristic of those grown in the United States, although the difference is not so marked in the case of wheat as it is in some other cereals. In general, the size of the grains of the domestic samples is less than that of the Canadian and foreign wheats, but in the World's Fair sam-

ples, as might be expected, the kernels were a little larger than those examined in previous work of the Department.

In respect of albuminoids, the American wheats, as a rule, are quite equal to those of foreign origin. This is an important characteristic when it is remembered that both the milling and food values of a wheat depend largely on the nitrogenous matter which is present. It must not be forgotten, however, that merely a high percentage of proteids is not always a sure indication of the milling value of a wheat. The percentage of gluten to the other proteid constituents of a wheat is not always constant, and it is the gluten content of a flour on which its bread-making qualities chiefly depend. The percentage of moist gluten gives in a rough way the property of the glutinous matter of absorbing and holding water under conditions as nearly constant as can be obtained. In general, it may be said that the ratio between the moist gluten and the dry gluten in a given sample is an index for comparison with other substances in the same sample. Upon the whole, however, the percentage of dry gluten must be regarded as the safer index of quality. In respect to the content of glutinous matter, our domestic wheats are distinctly superior to those of foreign origin. They are even better than the Canadian wheats in this respect. It may be fairly inferred, therefore, that while our domestic wheats give a flour slightly inferior in nutritive properties to that derived from foreign samples, it is nevertheless better adapted for baking purposes, and this quality more than compensates for its slight deficiency in respect of nutrition, a deficiency which, however, is so small as to be hardly worth considering.

In this connection, attention should be called to the great influence of climate upon the quality of wheat. The best wheats grown in the United States are produced in the central-northern part of the country, while the poorest are grown in the Southern States. The influence of climate and soil upon the quality of wheat has been fully pointed out by Richardson in Bulletins Nos. 1, 3, and 9 of the Chemical Division of the Department of Agriculture. The following quotation from page 25, Bulletin No. 9, will illustrate the above statement:

CHARACTERISTICS OF THE WHEAT GRAIN.

From observations in this and previous reports, it may be said that of all grain wheat is probably the most susceptible to its environment.

Oats in certain directions are more variable, but in their general character are more permanent, as will appear in subsequent pages. The inherent tendency to change which is found in all grains is most prominent in wheat. It may be fostered by selection and by modifying such of the conditions of environment as it is in the power of man to affect.

The most powerful element to contend with is the character of the season or unfavorable climatic conditions. The injury done in this way is well illustrated in Colorado, and it would seem advisable in such cases to seek seed from a source where everything has been favorable, and begin selection again.

It must be borne in mind that selection must be kept up continuously, and that reversion takes place more easily than improvement. It took but one season to seriously injure Professor Blount's wheats, but it will be two or more years before they have recovered from that injury. Hallett, in England, was able to make his celebrated pedigree wheat by selection, carried on through many years, but the same wheat grown by the ordinary farmer under unfavorable conditions for a few years without care has reverted to an ordinary sort of grain.

The effect of climate is well illustrated by four specimens of wheat which are to be seen in the collection of the Chemical Division. Two of these were from Oregon and Dakota some years ago, and present the most extreme contrast which can be found in this variable grain. One is light yellow, plump, and starchy, and shows on analysis a very small per cent of albuminoids; the other is one of the small, hard, and dark-colored spring wheats of Dakota, which are rich in albuminoids. Between these stand two specimens from Colorado, which have been raised from seed similar to the Oregon and Dakota wheat. They are scarcely distinguishable except by a slight difference in color. The Colorado climate is such as to have modified these two seed wheats, until after a few years' growth they are hardly distinguishable in the kernel.

All localities having widely different climates, soils, or other conditions produce their peculiar varieties and modify those brought to them.

The result of these tendencies to change and reversion from lack of care in seed selection or other cause has led to the practice of change of seed among farmers. A source is sought where either through greater care or more favorable conditions the variety desired has been able to hold its own. Sometimes this change is rendered necessary by conditions which are beyond the power of man to modify. As an example, No. 10 of Professor Blount's wheats, known as "Oregon Club," a white variety from Oregon, has been deteriorating every year since it has been grown in Colorado, whereas if the seed had been supplied every season directly from Oregon the quality would have probably remained the same. In extension of this illustration the fact may be mentioned that the annual renewal of the seed from a desirable and favorable source often makes it possible to raise cereals where otherwise climatic conditions would render their cultivation impossible through rapid reversion. This is particularly the case with extremes in latitude, the effect of which is not found so much upon the composition of the crop as on the yield and size of the grain. In the South, the warmer climate, together, of course, with poorer soil and cultivation in many instances, reduces the yield.

A typical American wheat of the best quality should have approximately the following composition:

Weight of 100 kernels	grams	3.85
Moisture	per cent	10.60
Albuminoids	do	12.25
Oil	do	1.75
Indigestible fiber	do	2.40
Ash	do	1.75
Digestible carbohydrates	do	71.25
Dry gluten	do	10.25
Moist gluten	do	26.50

To bring into a comparative view the means of the data obtained for American cereals exhibited at the World's Columbian Exposition, the following general table is given containing the data above mentioned, with the exception of those relating to rice, together with the approximate typical composition taken from the preceding pages:

Mean data calculated from the analyses of samples exhibited at the World's Columbian Exposition.

	Barley.	Buck-wheat.	Maize.	Oats.	Rye.	Wheat.
Weight of 100 kernels.....grams..	4.19	3.12	38.98	2.92	2.49	3.87
Moisture per cent..	10.80	12.15	10.93	10.06	10.62	10.62
Albuminoids do....	10.69	10.75	9.88	12.15	12.43	12.23
Oil do....	2.13	2.11	4.17	4.33	1.65	1.77
Fiber.....do....	4.05	10.75	1.71	12.07	2.09	2.36
Ash do....	2.44	1.89	1.36	3.46	1.92	1.82
Digestible carbohydrates.....do....	69.89	62.33	71.95	58.75	71.37	71.18

Approximate typical composition of domestic samples taken from the data given in the preceding pages.

Weight of 100 kernels.....grams..	4	3	38	3	2.50	3.85
Moisture per cent..	10.85	12	10.75	10	10.50	10.60
Albuminoids do....	11	10.75	10	12	12.25	12.25
Oil do....	2.25	2	4.25	4.50	1.50	1.75
Indigestible fiber.....do....	3.85	10.75	1.75	12	2.10	2.40
Ash do....	2.50	1.75	1.50	3.50	1.90	1.75
Digestible carbohydrates.....do....	69.45	62.75	71.75	58	71.75	71.25

INDEX.

A.

Page.

Albuminoids, percentage, in American wheats 51
Analysis, methods 7–11
Apparatus for nitrogen determination 9
Ash, determination 8
Awards, data used in ascertaining 11

B.

Barley, analyses of samples 13–15
comparison of analyses 16
description of samples 13–15
mean composition in different countries 18
notes on analyses 16, 17
table showing maximum, minimum, and mean data 17
typical American 18
valuation, for brewing 18, 19
Buckwheat, analyses of samples 20
description of samples 20
notes on analyses of samples 21
origin of samples 19
table of maximum, minimum, and mean analytical data 21
typical American 21, 22

C.

Carman, J. S., assistance 12
Cereals, comparative composition 53
comparison of approximate typical composition 53
Climate, influence, on composition of wheat 52
quality of wheat 51
Contents 5
Corn, origin of samples 22

E.

Ether extract, determination 8

F.

Fiber, determination of crude 10
Flour, gluten content 51
Food values, for awards 12

G.

Gluten, dry, determination 10
influence on bread making 51
moist determination 10

I.

Page.
Indian corn, origin of samples 22

J.

Jackson Park, data determined 7
laboratory, disposition 7

K.

Krug, W. H., assistance 12

L.

Letter of transmittal 3

M.

Maize, analyses of samples 23, 24
description of samples 23, 24
notes on analyses 25, 26
origin of samples 22
table of maximum, minimum, and mean data 25
typical American 26
Moisture, determination 8
low content in American cereals 50

N.

Nitrogen, determination 8, 9

O.

Oats, analyses of samples 27–29
composition of hulls 26
description of samples 27–29
notes on analytical data 30
origin of samples 26
table showing maximum, minimum, and mean analytical data 30
typical American 30, 31
use in United States 26
Official method, variation 11
Oil, determination 8

R.

Rice, analyses of samples 31, 32
composition of typical hulled 34
polished 35
unhulled 34
description of samples 31, 32
notes on analytical data 34
origin of samples 31
table of maximum, minimum, and mean analytical data 34
Richardson, Clifford, composition of American cereals 51
Rye, analyses of samples 36, 37
composition of typical American 38
description of samples 36, 37
extent of growth, in United States 38
notes on analytical data 38
origin of samples 35
table of maximum, minimum, and mean analytical data 38
use in United States 38

S.

Page
Samples, methods of taking 7
preparation 8
Shutt, Frank T., assistance 7

T.

Trescot, T. C., assistance 12

W.

Wheat, analyses of samples 40–48
characteristics 51, 52
composition of typical American 52
description of samples 40–48
geographical distribution of samples 38
milling properties 51
notes on analytical data 49–52
origin of samples 39
table of maximum, minimum, and mean analytical data 50

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